



**Washington State Patrol
Crime Laboratory Division**

Crime Scene Procedures Manual

February 2018

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1.0 GENERAL INFORMATION

Work outside the laboratory at crime scenes is an important component of the duties of Crime Laboratory Division (CLD) personnel. The purpose of the CLD Crime Scene Procedures Manual is to provide Crime Scene Response Team (CSRT) members with procedures and guidance that will:

- Further the CLD commitment to providing the highest quality forensic services, which ultimately enhances public safety for the citizens of Washington
- Promote seamless procedures between CLD work inside and outside the laboratory
- Assist CLD staff in performing assigned duties and tasks at crime scenes
- Ensure that the work product at crime scenes is of the highest quality possible
- Establish guidelines for scene requests while maintaining a high level of customer service

The guidance provided in this manual is designed to enhance information in the Washington State Patrol (WSP) Crime Laboratory Division Quality Operations Manual (CLD QOM) and Forensic Services Guide. These documents provide the definitive statements of policies and procedures for all work conducted by CLD employees within the individual laboratories of the Division, or while outside the laboratory, whether at crime scenes, in court, training venues, or anywhere else the assigned duties of CLD personnel might take them. This manual is not intended to cover all situations or to supersede agency policies or procedures.

The purpose of this manual is to assist CSRT members in performing assigned duties and tasks within the area of Crime Scene Response. It serves as one source of information on crime scene procedures commonly utilized by the WSP CLD. It is not comprehensive, and should not be regarded as an all-inclusive procedure on Crime Scene Response.

1.1 THE ROLE AND FUNCTION OF CRIME SCENE RESPONSE WITHIN CLD

Crime Scene Response is a specific discipline within the CLD of the WSP. The CLD is part of the Forensic Laboratory Services Bureau (FLSB) of the WSP. As such, there are established methods and procedures specific to this discipline. Crime Scene Response requires interaction with every functional area and forensic discipline within the CLD. For this reason, the Crime Scene Procedures Manual necessarily takes an inter-disciplinary approach to providing guidance in established methods and procedures.

The CSRT provides free crime scene assistance to law enforcement agencies in the investigation of major crimes. They assist local agencies with criminal investigations including: evidence recognition, evidence collection, bloodstain pattern analysis, trajectory analysis, scene documentation, and scene reconstruction. This assistance may take the form of physical response or remote consultation (e.g. by phone or email). Discretion will be utilized to ensure scene response meets the needs of the customer while maintaining the priorities of WSP. Denial of scene response may be necessary in instances where personnel are unavailable, budget constraints prohibit response, or the needs of the customer cannot be fulfilled by the WSP CSRT. Any reason for non-response will be communicated fully with the user agency by CSRT personnel and/or the CSRT Manager. The FLSB Director will also be notified.

1.2 CRIME SCENE RESPONSE AND INTERNATIONAL STANDARDS OF ACCREDITATION

The management system in the International Standard of ISO/IEC—meaning the quality, administrative, and technical systems that govern operations—applies equally in the crime scene environment as in the “controlled” laboratory environment.

Additional information regarding accreditation is found in the CLD QOM.

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1.3 QUALITY ASSURANCE

All crime scene scientists will work to continually maintain the highest degree of quality and integrity of laboratory services and to ensure that forensic conclusions are scientifically sound and valid. To this end, all laboratory analyses and related services performed by the CSRT shall meet generally recognized standards of the forensic community and its accrediting organizations. All scientists are required to familiarize themselves with the appropriate manuals and implement the CLD quality assurance policies and procedures in their work.

2.0 PRECAUTIONS AND SAFETY

2.1 RESPONSIBILITIES FOR HEALTH AND SAFETY

CLD maintains a health and safety program designed to safeguard employees from service-related injuries and health problems. The CLD Safety Manual documents the health and safety program of the CLD.

2.2 GENERAL SAFETY RESPONSIBILITIES OF CRIME SCENE PERSONNEL

The law enforcement agency requesting CSRT assistance is responsible for providing scene security. CSRT personnel should not begin scene processing until security has been provided and is being maintained. Any crime scene is to be approached cautiously with initial attentiveness to safety and continued alertness to potential hazards. CSRT personnel are responsible for following the safety procedures identified in the WSP CLD Safety Manual in addition to any safety precautions merited by a technical procedure conducted on-scene.

2.3 PRECAUTIONS AGAINST ROUTES OF BIOLOGICAL AND CHEMICAL CONTAMINATION

Standard laboratory safety protocols are to be followed in the field at a crime scene. In addition to hazardous materials CLD personnel may encounter at the crime scene, there are safety precautions particular to the use of chemical agents that may be essential to the crime scene analyst's work. Personal Protective Equipment (PPE), such as gloves, protective eyewear, appropriate respirators, and proper ventilation, should be employed, when required, to limit contact with biological and chemical reagents.

2.4 PROTECTION AGAINST POTENTIALLY INFECTIOUS MATERIALS

Gloves should, generally, be worn at all times while processing a crime scene and changed when appropriate. Depending on an assessment of the nature of the crime scene and the nature and concentration of potentially hazardous agents, additional suitable PPE such as Tyvek suits, field uniforms, jumpsuits, overshoes, shoe/boot covers, masks, and caps may be necessary.

Appropriate eye protection must be worn whenever a potential hazard to the eyes exists. This includes but is not limited to chemical exposure, alternate light sources (such as laser or ultraviolet), and the use of cutting tools.

2.5 CONFINED SPACE SAFETY

Crime Scene investigation may require the analyst to work in a confined space. Confined spaces can expose investigator(s) to hazards including toxic gases, explosive or oxygen-deficient atmospheres, electrical dangers or materials that can engulf personnel entering the space. General precautions for crime scene analysis in confined space include:

- Attention to ventilation and inhalation hazards
- Awareness of the potential for toxic gases, explosive or oxygen-deficient atmospheres
- Assessment of materials that could engulf and overwhelm personnel entering the space
- Electrical dangers
- Potential need for atmospheric monitoring
- Respiratory and personal protective equipment appropriate to the environment

Any confined space that contains unique hazards or requires special training will not be processed by members of the crime scene response team until the conditions are made safe or appropriately trained personnel are present.

2.6 FOLLOW-UP SAFETY PRECAUTIONS

All evidence should be packaged to prevent deleterious change such as exposure and contamination. Attention should be paid to potential seepage of liquid evidence including wet blood into/out of packaging materials.

Disposable materials contaminated with a potentially infectious material will be packaged and marked for disposal as a biohazard. If the requesting agency does not have the means to properly dispose of biohazard materials, the biohazard materials will be packaged and transported back to the responding laboratory for proper disposal.

Non-disposable examination utensils or equipment used in processing at the crime scene should be decontaminated on scene or placed in an appropriate container for subsequent cleaning and decontamination at the laboratory.

Soiled field uniforms used at crime scenes will be commercially laundered due to their potential for contamination with biological fluids and hazardous chemicals. See the WSP Regulation Manual for more information on uniforms.

Should a CSRT member later learn a blood source at a scene contained a blood borne pathogen, all other responding team members will be notified as soon as possible and the procedure for blood borne pathogen exposure in the WSP Regulation Manual will be followed.

3.0 DUTIES AND RESPONSIBILITIES

Duties and responsibilities within the discipline of Crime Scene Response follow the chain of command structure of CLD and are defined within the WSP CLD QOM. The Organizational Charts on the FLSB Portal illustrates the structure of authority along which both responsibilities and communications flow.

3.1 PERSONNEL

3.1.1 CRIME SCENE MANAGER

The CSRT Manager has oversight of processes that ensure high quality crime scene investigation, reconstruction, and analytical testing for cases submitted by the criminal justice community to the laboratory. The manager will ensure that CSRT maintains ISO 17025 criteria. The manager will control expenditures of discretionary funds.

The role of the team manager is to field calls for crime scene response, maintain the call out schedule, present reports to management and other stakeholders, coordinate training opportunities for team members and user agencies, and other similar duties. The crime scene manager typically does not respond to call outs. These duties can be delegated to other CSRT personnel at the discretion of the Division Commander.

3.1.2 3.1.2 TECHNICAL LEAD

The role of the technical lead is to field calls for crime scene response, coordinate technical reviews, monitor the quality and timeliness of CSRT work product, make decisions regarding the technical practices and procedures performed at crime scenes. They also preside over training events and activities, monitor the progress of training plans for members of CSRT, and provide training and training opportunities for team members and user agencies, and other similar duties.

The technical lead reports to the CSRT Manager regarding program activities and issues. They present reports to agency leadership, client and stakeholder groups, and at public events. They also act in administrative capacities when assigned by the CSRT Manager.

The technical lead also responds to call outs and acts as a primary responder.

3.1.3 PRIMARY RESPONDER

A primary responder is a fully functional crime scene responder and generally is the lead at the scene. They may delegate different aspects of the scene to the other responders on-scene, and are ultimately responsible for the resulting report and any courtroom testimony.

3.1.4 SECONDARY RESPONDER

The secondary responder functions as an assistant to the primary responder at the scene.

3.1.5 TRAINEE RESPONDER

The trainee is a responder who is not yet taking on unsupervised crime scene responsibilities however, will assist at scenes. The length of a person in trainee status depends on previous exposure to scenes and the progress of the trainee.

3.2 INITIAL RESPONSE

Initial request(s) for CSRT assistance generally come from law enforcement agencies investigating crimes. The CSRT Manager, or someone directed to assume those duties, will evaluate the request to deem the appropriateness of CSRT response. They will contact the on-call personnel

with the initial scene information, including the requesting agency representative contact information.

Responding CSRT personnel are expected to obtain and document key information immediately upon receipt of the initial request. This includes the time and date of the request, specific information regarding the scene, the source of that information, and may include, but not limited to, the address, description of the location, time and date of the initial incident, type of incident, and the parties or weapons involved.

Steps in initial response include attempting to determine if any specialized services or equipment may be required, ascertaining whether the requesting agency has obtained or needs to obtain a search warrant, and providing the requesting agency with an estimated time of arrival.

For responses that may be scheduled at a later date (vehicle searches, etc), every effort will be made to conduct the response during normal business hours.

3.3 PRELIMINARY SCENE APPROACH

Document any initial information provided by the requesting law enforcement agency including obtaining a completed Request for Laboratory Examination (RFLE) form from the requesting agency. This initial documentation should include the name of the investigating agency and case number, if one is available, the contact information including phone number(s) for the lead investigator, the scene location, and victim and suspect information, if known.

Ensure applicable search warrants have been obtained by the requesting agency and obtain a copy if possible.

3.4 SCENE ASSESSMENT

Initial scene assessment is designed to ensure the recognition, documentation, collection, and preservation of physical evidence. Consultation with requesting agencies will identify boundaries encompassing all potential areas of interest, establish a path of entry to be used by all personnel entering the scene, and lay the framework for identifying and collecting items of evidence. The primary responder may also delegate tasks to other responders during this initial scene evaluation.

Prioritizing the scene investigation supports the quality of the investigation and the appropriate allocation of available resources. It also allows the identification and protection of potentially fragile and/or perishable evidence.

Once the boundaries of the crime scene have been established, identify a staging area for equipment, supplies, and collected evidence. This area should be located outside the actual scene when practical, but within the parameters of the secured area. The staging area may be inside a house, for example, if all of the scene evidence is confined to a certain area or if environmental factors at the scene become an issue.

Any biological or chemical hazards will be identified upon initial scene assessment. Should additional hazards become apparent after scene processing has begun, re-evaluation of scene processing may be necessary.

The scope of the CSRT response is defined by the requesting agency and the responding team's capabilities as defined in this manual. All agency requests supersede the mandates laid out in this manual; however, they must be documented.

4.0 SCENE DOCUMENTATION

Crime scene documentation is extremely important to provide a detailed record of observations, aid in report writing, assist with testimony, and allow for independent review by other expert(s). This may include preliminary photographs, rough sketches, and notes. All case file documentation requirements outlined in the CLD QOM will be followed. The case file must reflect the start and ending dates of the CSRT callout. The start date will reflect the date of the initial callout and end with the completion of administrative review process.

4.1 NOTE TAKING

Note taking is an essential component of a crime scene investigation, the quality and completeness of which is often critical to a complete analysis of a crime scene.

4.1.1 ESSENTIAL GUIDELINES AND PRINCIPLES FOR NOTE TAKING:

- Note taking is a running and continuous description of the crime scene. It should be inclusive of the crime scene from start to finish
- Nothing is insignificant to record if it catches the attention or the eye of the crime scene analyst
- Error on the side of too much detail, rather than too little detail
- Use photographs and sketches to supplement the notes (including scene measurements)
- When appropriate include descriptors of environmental conditions including weather, lighting conditions, temperature extremes, odors, etc
- Provide information on the identity of all WSP responders, requesting agency representatives present at the scene, and first responder information, if available
- The position and condition of the evidence, including measurements when appropriate
- Retain all notes even if rewritten
- All reagents must have lot numbers recorded, and all water used in reagent preparation should be deionized when appropriate
- All field notes/sketches shall have the initials of the individual that prepared them

4.1.2 METHODS OF MEASUREMENT

When the crime scene analyst records distances/heights or produces a sketch/diagram, measurements should provide a reference of the dimensions, show the relationships of objects, and when necessary, properly document the scene to enable scale reproductions.

It is appropriate to use diagrams provided by WSP CID or the requesting agency's total station unit for demonstrative purposes only. It is ultimately the primary responder's responsibility to ensure measurements needed for reconstruction purposes are taken. Measurements taken at a crime scene will be considered approximations.

Measurements are also used when locating evidence on-scene. The following are examples of techniques used in locating evidence:

- **Rectangular coordinates (coordinate method):** two measurements at right angles are made from fixed objects, such as a wall, to the item. Indicate the location of the

fixed object and the direction measured; for example “67” east of west wall” and “4 ft. 6 in. south of north wall”

- **Triangulation:** Measurements are taken between two fixed objects and then from the fixed objects to the item, forming a triangle
- **Polar Coordinates:** Measure from a fixed object (eg. a building) to the item. Then measure the angle in a clockwise direction between the measuring line and a line through the fixed object
- **Base line measurements:** Lay down a tape measure or string across the entire room or area to be measured. Establish a starting point and an ending point, which will each be noted as a reference point (RP), designated by a number or letter. Fix both RP's so they can be re-established, if necessary at a later time. The tape, which runs between the two RP's, becomes the base line for all other measurements in the crime scene. Measurements are then made from this tape (baseline) by laying another tape measure perpendicular to the baseline out to the item of evidence or point of interest

4.2 DIAGRAMMING

Crime scene diagrams and sketches support the photographs and notes taken at the scene. They also serve to establish spatial relationships, provide an overall scene view, assist with preparation of demonstrative aides for court and serve as an investigative aide during interviews. In addition, diagrams can clarify items of evidence in a crime scene without extraneous items such as furniture, piles of debris, etc. being represented in the diagram.

Determine the best perspective and method of sketching the scene when appropriate. Consider items that should be included and excluded depending on what is being represented and what may be important relationally. Clearly label the objects included in the diagram. Indicate the perspective of the diagram in your notes (i.e. overhead, side, etc.). Overlays may be used to assist in documentation.

To-scale diagrams may be produced at the laboratory based on scene measurements and observations. To clearly indicate the difference between scale and not-to-scale diagrams, label each diagram appropriately and include a scale on to-scale diagrams.

4.3 PHOTOGRAPHY

Photographs provide visual documentation of a crime scene. Overall photographs establish the location of specific items and evidence within the context of the scene. Additionally, they record the condition of the scene as first found by WSP CSRT. For these reasons, it is important to photograph the entire scene prior to processing the scene or evidence collection. RAW, TIFF and/or JPEG digital format may be used for photodocumenting a crime scene. All three formats are acceptable.

To properly document a scene, long range (overall), mid-range, and close-up photographs should be taken when appropriate or when the scene allows.

- Long range photographs show where evidence or items are located within the entire context of the scene.
- Mid-range photographs show the item within its immediate surroundings and position relative to other adjacent items or evidence.
- Close-up photographs are used for identifying specific items of evidence and documenting more specific detailed patterns or impressions

The following is a general photography guideline for documenting the scene. When the scene allows, photograph:

- Three hundred-sixty degree perimeter view of the entire scene
- Scene location as established by identifiable landmarks (i.e. street signs, addresses, adjacent buildings or landscape)
- Access routes to and from the scene, and in the case of buildings, all entrances and exits to the structure
- Overall views showing overlapping areas. In the case of an indoor crime scene, this would be overlapping serial views of each room including ceilings, doorways, hallways, etc. (when appropriate)
- Mid-range photographs of evidence establishing location relative to reference points and other items of evidence
- Close-up views of evidence items with evidence numbers and scales when possible
- Before and after photographs depicting locations of portions of walls, doors, car parts, flooring, carpeting, upholstery, etc. removed as evidence.

4.4 DIGITAL IMAGES

Images of the crime scene used to depict a true and accurate representation of what was observed and processed (overall, mid-range and close-up images) may be acquired using formats such as RAW, TIFF or JPEG.

Examination quality images should be taken of impression and latent print evidence as needed. These images will be taken in an uncompressed format (e.g., TIFF or RAW). High resolution JPEG images may be taken in tandem with the uncompressed images.

Only a single case should be recorded on any one media card at a time. If the first media card is filled during a single case, a second media card can also be used and should be reflected in the notes. If multiple cameras are used on scene, this will be documented in the notes.

If an image is unacceptable, additional images should be taken. No images will be deleted.

4.4.1 DISPOSITION OF DIGITAL IMAGES PRIOR TO CLEARING THE SCENE

The original digital images in JPEG format and any exam quality images in RAW (NEF) format should be transferred to the agency on the media card(s) from the camera prior to departing the scene as an item of evidence. The packaging for the media card(s) containing these images will be marked with, at minimum, a unique identifier, the date it was packaged, the CLD case number (if available), the investigating agency case number, and the scientist's initials. Record the number of images in your case notes and verify that the number of images was transferred to the storage media. Transfer the memory card(s) to the investigating agency along with all collected evidence.

The images in RAW (NEF) format will be retained by the scientist (see section 4.4.3 for digital image management).

If the crime scene requires an overnight stay, the memory card(s) containing the digital images should be secured on a CSRT person or within the room as appropriate throughout the duration of the stay.

4.4.2 DISPOSITION OF DIGITAL IMAGES UPON RETURN TO THE LABORATORY:

If the images were not released to the agency prior to clearing the scene, record the date and time the digital images on the media card were brought into the lab in your notes to initiate the Chain of Custody (COC). The media card must be stored securely in an evidence locker until the images can be copied/transferred to unalterable permanent storage media (CD-R or DVD-R) and released to the investigating agency. The appropriate storage location must be documented in the notes. The reason for not releasing the images on scene must also be included in the notes.

Copy/transfer the original digital images in JPEG format and any exam quality images in RAW (NEF) format onto unalterable permanent storage media (CD-R or DVD). This original disc(s) will be marked with, at minimum, a unique identifier, the date it was created, the CLD case number, the investigating agency case number, and the scientist's initials. Record the number of images in your case notes and verify that the total number of images was transferred to the storage media. Enter the original disc in LIMS as a new item of evidence (e.g., Item 1: One CD/DVD containing xx number of images from crime scene) and record that information in your case notes. The original disc can then be returned to the investigating agency (either by shipping or in person). The shipping records or confirmation signature of the agency representative should be retained with the case file to document the COC.

If the digital images were released to the requesting agency prior to clearing the scene, the examiner will follow the guidelines under section 4.4.3 for digital image management upon return to the laboratory.

4.4.3 DIGITAL IMAGE MANAGEMENT

If the examiner's digital image workflow will be done in Adobe Photoshop Lightroom®, the original RAW (NEF) format digital image files will be transferred to the examiner's computer hard drive or external hard drive. These images will then be imported into Lightroom® through the Library module ensuring that any changes made to the images are written to .XMP sidecar files. Once the images are imported to Lightroom®, they may be modified or resized for illustration or demonstrative purposes. After resizing and/or modifying images they may be exported in JPEG format for inclusion to the case file as standalone images or incorporated into other software such as Microsoft® PowerPoint for further annotation. After all edits are made to the digital images they will be exported in DNG format with the original RAW (NEF) files and XMP files embedded. These DNG files will be uploaded to a secure Digital Imaging System (DIS) or saved to unalterable permanent storage media (CD-R or DVD-R) and kept in the case record. If a secure server is used, the images will be uploaded to the archiving system under the laboratory case number at the assigned scientist's laboratory unless an alternative is noted in the case record. The server name will be documented in the case notes.

Any modifications performed in Photoshop or other image enhancement software will require edit history logs to be included when applicable. These images will be saved to unalterable permanent storage media (CD-R or DVD) and kept in the case record or uploaded to a DIS.

If the examiner's digital image workflow involves edits through the secure DIS without processing in Lightroom®, the original RAW (NEF) format digital image files will be uploaded directly to the DIS and all changes will be tracked through the DIS. The server name will be documented in the case notes.

The CSRT media card should be cleared of images for reuse.

4.5 SPECIAL CONSIDERATIONS - PHOTOGRAPHY

4.5.1 PHOTOGRAPHY AT NIGHT

Some crime scenes cover a large area that must be photographed on a single image to show the relationship among details. Night scenes pose a problem because the area may be too large to be illuminated by a single flash firing only once. The proper exposure can be created by painting the area with light. This technique can effectively light up a large area on one exposure; however, like

all specialized techniques, it is better to bracket a number of exposures to ensure that the information is obtained.

Procedure

Multiple people may be required to perform this procedure. Designate one individual as the camera operator and any others to supply an external light source.

- Setup the camera on a secure tripod and lock it in place. Set the camera on manual, put on the proper ISO setting (start with lowest ISO such as 64) and adjust as needed. Place on either B(bulb) or S (shutter)
- Determine how many flashes it will take to properly expose up the area
- Determine the distance the flash should cover on each exposure
- Start with an aperture (f/stop) of f/8 and adjust accordingly
- Adjust the white balance as needed
- Turn on the flash and allow it to fully charge while the flash operator gets in position
- Place something dark in front of the lens and lock the shutter open with a cable release cord or shutter button release
- Point the flash to cover the first area of the photograph, ensuring the flash operator does not get in between the flash and camera. Once the camera operator removes the dark object from in front of lens, the flash operator fires the flash manually
- Once the flash has fired, re-cover the lens with the dark object until the flash operator is in position for the second exposure, and so on, until the appropriate number of flashes has properly exposed the area
- Once the pre-determined number of flashes have been fired, end the exposure
- Repeat with other exposures to ensure the desired results are obtained
- The use of a flashlight can be used to illuminate the area of interest without the use of a flash

4.5.2 PHOTOGRAPHY OF LUMINOL/BLUESTAR®

Some scenes may require the use of Luminol or Bluestar® to detect latent blood. The very nature of the chemiluminescence can be photographed to record the reactions. The light conditions necessary for photographing these chemiluminescent reactions are the same as for viewing. This process generally requires two analysts, one to operate the camera and one to spray the blood enhancement reagent. A video camera to record the chemiluminescence can also be set up.

Preparation

Viewing and photographing chemiluminescent reactions require the same environmental preparations to reduce or eliminate available light. Indoor scenes should be darkened as much as possible. The use of light blocking material may be necessary to cover windows and doors. Outdoor scenes should be photographed at night with as few lights illuminated as possible.

Procedure

The camera operator should be experienced with this type of photography.

- Place the camera on a tripod. If a video camera is also going to be used, a second tripod should be set-up. The videography can begin before the reagent is applied
- Photograph the area prior to applying Luminol. The camera and tripod should not be moved until all photographs of a specific area have been taken
- Ensure the built-in flash is turned off and set the camera's aperture and shutter speed to the appropriate settings. In most cases, an aperture setting of approximately f4.5 and a 30 second exposure should be sufficient
- Spray the reagent. When the chemiluminescent reaction becomes visible, begin the exposure. Continue spraying reagent, as needed, throughout the exposure
- Sometime during the exposure, an external flash can be manually fired above the chemiluminescent area. This may provide a small amount of light to illuminate the area without overpowering the chemiluminescence (if the ceiling is high, the flash may need to be bounced off an adjacent wall or object)
- Move the camera and tripod to a new area and repeat the procedure, as necessary

The chemiluminescence will only last for a short period of time and will start to diminish after approximately 30 seconds.

4.5.3 PHOTOGRAPHY OF FLUORESCENCE

- Photograph the enhanced fluorescing bloodstained areas with an orange barrier filter and a camera mounted on a tripod.
- The camera settings can be set on manual mode with the shutter on bulb setting. The exposure time will depend on the amount of light in the room. .
- Be sure to photograph areas of interest such as friction ridge impressions, footwear impressions and blood spatter with a scale and at 90 degrees (parallel to the plane).

4.5.4 PHOTOGRAPHY OF IMPRESSION EVIDENCE

In the case of fragile impressions (such as impressions in snow, sand, mud, or blood), it is important to photograph the impression as soon as possible to prevent loss through environmental or other factors. Procedures for impression collection are identified in Section 9.0 of this manual.

To photograph a 3D impression (one with depth), do the following:

- Take mid-range photographs of the impression in-context
- Securely mount the camera to a tripod
- Place the tripod over the impression ensuring the back of the camera (the sensor plane) is parallel to the impression. A small level or angle finder is useful in assuring the camera is perpendicular to the angle of the impression
- Examination quality images must be captured in RAW or TIFF format
- Take close-up photographs, making sure the impression is substantially filling the photographic frame
- Place a measuring device (scale) alongside the impression making sure that the scale is near the level of the bottom of the impression without covering or obliterating it

- Create oblique lighting from several angles using an off-camera flash unit or flashlights. Note that flashlights may produce hot spots in the photograph
- Take additional photographs while moving the flash or flashlight to the opposite sides of the impression to provide counter shadows

Examination quality photographs of impressions that contain both identification information and scales are critical for the preservation and documentation of impression evidence. Scales that run the length and width of an impression may be used, although the use of an L-shaped scale is best.

4.6 VIDEOGRAPHY

Video recording, in addition to photography, may be used as a method of documenting the crime scene. Videography supports but does not eliminate the need for still photographs.

Techniques for making a video recording of a crime scene follow similar protocols as still photography. It should include an overall view of the crime scene including surrounding landmarks, an intermediate view showing the position of items and evidence within their immediate surroundings, and a close-up view that allows for the identification of specific items.

The sound component of the video recorder should be turned off during the crime scene documentation.

4.6.1 SPECIAL CONSIDERATIONS – VIDEO OF FLUORESCENCE

Record the results, using an appropriate barrier filter (orange or yellow), with the video camera mounted on a tripod. Video record as areas are being processed before, during, and after the bloodstained areas are identified.

4.7 PHOTOGRAPHY EQUIPMENT QUALITY ASSURANCE

4.7.1 LOGBOOKS

Information regarding digital single lens reflex (DSLR) cameras and accessories may be recorded in a single logbook or divided up into different logbooks depending on the needs of the particular laboratory. Any maintenance (excluding preventative measures and routine cleaning) to a camera or an accessory to a camera must be recorded in the logbook. Outside services must be recorded in the logbook.

4.7.2 MAINTENANCE

DSLR cameras and accessories require very little outside maintenance. Most of the user maintenance on the cameras and accessories will consist of preventive measures and routine cleaning. Occasionally, routine maintenance such as sensor cleaning can be performed by an outside vendor. If an outside vendor needs to be contacted, notify the CSRT Manager.

Preventive measures include:

- Turning off the camera before removing an attached lens
- Avoiding harsh cleaners such as solvents
- Removing batteries from the camera body and flash units when not in use
- Storing the camera and accessories in a dry, well-ventilated area

Routine cleaning includes:

- Using a blower to remove dust from the camera body, lens, mirror, and viewfinder
- Gently wiping the exterior of the camera body and accessories with a cloth
- Applying a small amount of lens cleaner to the lens and wiping with a soft cloth

4.7.3 PERFORMANCE VERIFICATIONS

Performance verifications are not required for DSLR cameras and accessories because the images that are created indicate whether the equipment is working properly.

4.7.4 SAFETY

Keep the sun well out of the frame when shooting if possible. Sunlight focused into the camera when the sun is in or close to the frame could cause a fire. Viewing the sun or other alternate light sources through the viewfinder could cause visual impairment.

5.0 EVIDENCE COLLECTION AND PRESERVATION

The discipline of Crime Scene Response requires diverse skills in scene processing including the collection, preservation, and the inventory of physical evidence. Types of evidence may include but are not limited to latent prints, footwear or tire impressions, biological fluids/stains, trace evidence, and firearms evidence.

Crime scene analysis requires a systematic and thorough search of the scene. It is incumbent upon the analyst to identify and collect, or direct collection, of evidence.

The WSP CLD QOM and the Forensic Services Guide define the procedures for evidence handling, packaging, and collection. These procedures are applicable to evidence collected by CSRT personnel. The procedures identified in this manual are designed to enhance and explicate—and not replace—the procedures for evidence collection and packaging presented in other CLD manuals. Deviations from established procedures will be documented in the analyst's notes.

Evidence collected by CSRT personnel will be fully documented, identified, and packaged as to protect it from loss, cross transfer, contamination, and/or deleterious change. All evidence will be turned over to the agency with jurisdiction over the case prior to clearing the scene.

5.1 EVIDENCE COLLECTION

The validity of information derived from a crime scene investigation depends on the items of evidence being collected, handled, and stored correctly. CSRT personnel will process a scene in such a way to ensure the integrity of the evidence and protect it from contamination. Reference the Forensic Services Guide for evidence collection guidelines and specific packaging instruction.

5.2 EVIDENCE PACKAGING AND PRESERVATION

Evidence collected from a crime scene by laboratory personnel shall be protected from loss, cross transfer, contamination and/or deleterious change, whether in a sealed or unsealed container. Where appropriate, further processing to preserve, evaluate, document, or rendering the evidence safe, shall be accomplished prior to final packaging. Evidence packaging must be marked with a unique case number, such as the requesting agency case number, and a unique item number. The WSP CLD QOM and the Forensic Services Guide provide further operative guidance for evidence packaging, marking, and sealing.

5.3 COMPUTER AND DIGITAL IMAGING EVIDENCE

The crime scene analyst is concerned with both digital imaging as a tool for electronically recording evidence from the crime scene, and also with digital evidence in many different formats that may be recovered from the crime scene.

Digital evidence recovery may present unique challenges. Personnel with expertise in electronic crime investigation may be needed to collect digital evidence. In the absence of the requesting agency having computer forensic experts, the [WSP Special Investigations High Tech Crime Unit \(HTCU\)](#) may be contacted for consultation.

5.4 POST SCENE RESPONSIBILITIES

Final survey of the crime scene is a systematic review prior to leaving the crime scene. It is made to ensure that all identified evidence has been collected and that no evidence or materials generated by the investigation, and equipment used are not inadvertently left behind. CSRT will be sure if any dangerous materials or conditions are present in the scene that they have been reported and addressed prior to clearing the scene.

The requesting agency should be given instruction on how to properly store and preserve the collected evidence prior to it being submitted to the laboratory for analysis (i.e. drying wet bloodied items prior to sealing its final packaging material, freezing/refrigerating DNA evidence).

Equipment used at the crime scene must be decontaminated, either prior to putting it away in the vehicle or as soon as possible upon returning to the laboratory.

6.0 BIOLOGICAL EVIDENCE

Biological evidence such as liquid or dried blood, semen, saliva, tissue, hair, urine, feces, bones, or teeth may be important to the investigation of a crime.

6.1 PRESUMPTIVE TEST FOR BLOOD

Initial examination is frequently necessary at crime scenes to screen evidence for the possible presence of a relevant biological substance, such as blood. When selecting a potential stain or doing a general swab for blood, evaluate the area to ensure no other evidence will be disrupted (i.e. friction ridge detail, hairs, etc). These presumptive tests are not species-specific and will produce a positive reaction with animal blood.

6.1.1 PHENOLPHTHALEIN

Phenolphthalein is a catalytic test for the presumptive identification of blood based upon the peroxidase-like activity of hemoglobin. Use of phenolphthalein follows the procedure outlined in the WSP Biochemical Analysis Procedures Manual.

It may be necessary to collect phenolphthalein positive swabs if the sample being collected is of limited quantity.

Note on the swab box and outer packaging whether the collected sample was positive for the presence of blood.

6.2 CONFIRMATORY TEST FOR BLOOD

The examination of bloodstains to determine if they are human blood is sometimes necessary to verify if further analysis of these bloodstain patterns are necessary and/or associated with a criminal event.

6.2.1 ABACARD[®] HEMATRACE[®]

A Hematrace[®] test will only be conducted on presumptively positive visual bloodstains. Product literature reports that the lower limit of sensitivity for human hemoglobin is approximately 1 in 1,000,000 dilution of whole human blood.

A "High Dose Hook Effect" may be seen for extremely concentrated human hemoglobin samples (such as whole human blood) which appears as a negative result. All samples will be diluted in the running buffer to avoid this issue.

It has been reported that ferret blood and upper primate blood can produce a false positive results with this product.

Procedure:

- Collect suspected stain onto a cotton swab.
- Break the head of the cotton swab into the running buffer container (provided in Hematrace[®] kit). Soak the sample for 5 minutes gently swirling the sample for 10 seconds or more without foaming the buffer.
- Using the supplied dropper add 4-5 drops of the incubated sample liquid to the sample well "S" of the test card.
- The results shall be recorded at ten minutes.

- Ensure that there is a pink line at the control area "C." If there is no pink line visible at the control area "C" the test is inconclusive.
- If there is a pink line at the "T" area the sample is positive for human hemoglobin.
- If no pink line is visible at the "T" area the sample is negative for human hemoglobin.

Precautions:

Do not store cards in extreme heat for long periods of time (above 130°F).

If buffer is frozen, thaw before use.

6.3 CHEMICAL BLOOD ENHANCEMENT TECHNIQUES

There are a number of blood detection and enhancement reagents available for use by crime scene investigators. The use of these detection and enhancement reagents will be left up to analyst discretion. These include, but not limited to, Leuco Crystal Violet, Luminol, Bluestar[®] Forensic, Amido Black, and Fluorescein, which are useful in the detection of trace amounts of blood at a crime scene. Consideration must be given to the use of these techniques if subsequent DNA analysis will be conducted as they may inhibit the DNA typing process. Typically, any blood enhancement technique is conducted after all other analysis on-scene is complete.

6.3.1 LEUCO CRYSTAL VIOLET (LCV)

LCV is an enhancement/presumptive test for blood. LCV may assist in crime scenes when there is suspicion that blood may have been cleaned up from a surface and/or is no longer visible to the naked eye.

LCV is the reduced (colorless) form of crystal violet. When LCV and hydrogen peroxide come into contact with the hemoglobin in blood, an oxidation reaction catalyzed by the peroxidase-like activity of the hemoglobin will occur, resulting in a dark violet color. The resulting violet color may enhance the contrast of the impression on the substrate, or may develop non-visible stains.

Cautions

LCV crystals should not be used once they have turned yellow. An assessment of the crime scene must be made to determine if such activities can be accomplished safely and successfully.

Procedure

Take photographs of the area to be treated prior to any enhancement attempts. For potential impressions, take examination quality photographs.

- A positive and negative control must be tested prior to use each day the reagent is used and documented in the case notes.
- Apply the LCV reagent to the area of interest. This is typically done by spraying a fine mist of the reagent.
- Development is typically within 30 seconds.
- Allow the processed area to air dry.

Documentation

Photograph the area after enhancement. Should an impression be present, take examination quality photographs.

Case notes must have some statement(s) addressing the quantity and description of enhanced bloodstains/impressions located, along with which one(s) were enhanced. This may be aided with, but not replaced by, photographs.

6.3.2 LUMINOL

Luminol based reagents are presumptive tests for blood and may assist in crime scenes where blood has been cleaned up from a surface and is no longer visible to the naked eye. Luminol can readily detect old bloodstains and minute amounts of blood that have been washed out or cleaned up.

Luminol is a chemical that reacts with the heme compounds found in blood to produce a blue-colored chemiluminescence visible in a darkened area. Heme compounds also exist in most animal blood, so a positive reaction is not species-specific.

Cautions

- Because luminol can only be visualized in darkened areas, it should only be used at crime scenes where darkening the entire area is possible.
- The use of luminol may cause dried bloodstains to dissolve, negatively affecting any impression or pattern evidence. If pattern evidence, such as footwear impressions, is located, luminol use should be immediately discontinued until there is an assessment of the evidence priorities and the best way of proceeding.
- Luminol could further dilute an already diluted stain, pushing the stain beyond the DNA analysis detection limits.
- Care should be taken that spraying luminol at a crime scene does not impede movement around the crime scene without tracking the luminol around the scene and possibly contaminating other evidence.

Procedure:

- A positive and negative control must be tested prior to use each day the reagent is used and documented in the case notes
- The area where the luminol reagent will be used should be as dark as possible. Extinguish all light sources and, if necessary, cover windows with some kind of material to darken the area.
- Spray a fine mist of the reagent solution in a sweeping motion over the area of interest. Avoid saturation of the area.
- Photographs can also be taken for additional documentation of chemiluminescence related to bloodstains (see section 4.5.2).
- If a positive reaction is observed, additional misting might enhance results for photographing, with care taken not to dilute the stain.

Interpretation:

A positive presumptive reaction to blood will produce a blue-colored luminescence visible for a short duration of time (~30 seconds) in the darkened environment. Observation of a pattern of luminescence in the sprayed area can be interpreted as a positive result. No luminescence or where the entire area sprayed is chemiluminescent with no discernable pattern visible can be interpreted as a negative result.

False positive reactions may occur as a result of the presence of peroxidases, metal ions, or oxidants. The most common of these interfering substances are hypochlorite-based bleaches,

some vegetable matter, and metal ions such as copper. With the exception of copper, luminol reactions with items other than blood are generally different in their duration and intensity.

A presumptive positive reaction for the presence of blood should be subsequently tested using the phenolphthalein reagent. A positive result is an indication for the presence of blood and a sample of that area may need to be collected for DNA testing. A negative result when using phenolphthalein as a follow-up would not usually be collected as it may be a false positive or the sample is too dilute for DNA testing.

False negative reactions may occur as a result of strong oxidizing agents or other interfering substances.

6.3.3 BLUESTAR® FORENSIC

Bluestar® Forensic may be used to assist in locating latent bloodstains and may be useful at crime scenes where bloodstains may have been washed out, wiped off, or otherwise concealed.

The cautions, testing procedure, and interpretation for Bluestar® Forensic are similar to that of luminol (see section 6.3.2 above).

Caution: Bluestar® is available commercially as a training version and is detrimental to DNA. The training version is for training only and shall not be used in the processing of a crime scene.

6.3.4 FLUORESCCEIN

Latent bloodstains have been shown to fluoresce after being treated with the fluorescein solution and visualized using an Alternate Light Source (ALS). Fluorescein reacts with the heme structure in blood and is oxidized from a colorless chemical to fluorescent fluorescein. In general, the fluorescence is best viewed at a wavelength of 450 – 485 nm with the aid of an orange or yellow barrier filter.

Cautions

Use gloves during testing. Always wear proper eye protection when utilizing the ALS. Never look directly into the light or allow beams to bounce off surfaces into your eyes or other persons in the vicinity. Respiratory protection is not normally required for this procedure.

Make sure all open flames are extinguished prior to the application or the mixing of the fluorescein reagent. Ethanol is flammable and could cause a fire or explosion.

Limitations and Precautions

The purpose of this technique is to enhance any latent blood that may be present. It will not differentiate between human and non-human blood.

There are numerous materials which will fluoresce both before and after the application of fluorescein. This can cause false positives to be detected. Some materials which can cause false positives are rust, bleach, oils, and certain detergents.

Procedure

The application of fluorescein is a two part process. Place the working fluorescein reagent in a spray bottle. The second application process involves an overspray using 3% hydrogen peroxide. Place the 3% hydrogen peroxide in a separate spray bottle.

A positive and negative control must be tested prior to use each day the reagent is used. This quality control check will be documented in the case notes.

Inherent Fluorescence: Prior to the application of any chemicals to the crime scene or evidence, examine the surface with an ALS for any inherent fluorescence. Note already existing fluorescing stains or areas. Ambient light must be limited; however, total darkness is not necessary.

- All crime scene documentation and evidence collection, in the area to be processed, should be complete prior to the application of fluorescein.
- Spray the target area with a fine uniform mist of the fluorescein working solution (do not over spray).
- Note any fluorescing observed with an ALS after the application of this reagent alone. Materials that fluoresce prior to the application of the hydrogen peroxide are false positive reactions and do not indicate the presence of blood.
- Spray the area with a fine mist of 3% hydrogen peroxide solution.
- Areas of fluorescence may be marked using a fluorescing marker (highlighters work well).
- Document the fluorescence with still photography and, if desired, video documentation can also be used.

Interpretation

Application of the fluorescein reagent on the suspected area containing bloodstains will develop a yellow fluorescence when viewed with an ALS within approximately 30 seconds if blood is present. At this stage, the bloodstain and some background fluorescence will be apparent. The application of the hydrogen peroxide solution however will help to intensify the color change and reduce the background.

6.3.5 AMIDO BLACK

Amido black, also known as naphthol blue-black, is an enhancement technique for use on faint, bloody impressions that have been left in blood on both porous and nonporous surfaces. It reacts with proteins present in blood and results in a blue-black color, typically increasing the contrast of the impression on the substrate.

Cautions

Amido black is a reagent known to interfere with DNA analysis. Any sampling for potential DNA analysis should be performed prior to the application of the amido black reagent.

Procedure

All blood must be dried prior to application. A positive and negative control must be tested prior to use each day the reagent is used and documented in the case notes. A positive test will result in the development of a blue/black print.

1. Take examination quality photographs of the impression prior to any enhancement attempts.
2. Stain and rinse a small area of substrate that is not part of the impression to check for background staining. Should background staining occur, do not use this enhancement method.
3. Fix the bloody impression to ensure that it is not dissolved or washed away during the enhancement process. This step may be omitted if a fixing agent is included in the reagent. To fix an impression, spray the impression (or immerse it if moveable) with 2% 5-sulfosalicyclic acid for approximately 10 minutes, then immerse or rinse for approximately 5 minutes with water.

4. Saturate the impression with the amido black reagent. This may be done by spraying or pouring the reagent onto the impression, or immerse the impression on a portable object into a tray containing the reagent.
5. Development is typically quick, but allow for a minute or two to pass to ensure complete development for the methanol based reagent and 3-5 minutes for the water based reagent.
6. Rinse the impression with the de-stain solution, removing the stain from the background.
7. The impression may be re-stained to make darker, if necessary.
8. Repeat the rinse using deionized water if methanol-based reagent was used.
9. Allow the impression to air dry or blot the area carefully with a paper towel or tissue.
10. Take examination quality photograph(s) of the enhanced impression and/or collect, package, and preserve the entire enhanced impression.

Amido black can follow LCV processing in cases where a color change or better contrast is sought.

Apply the developer to the item by dipping or using a sprayer or squirt bottle to cover the target surface. Sufficient staining normally occurs in less than 2 minutes. Then apply the rinse. These two steps can be repeated to possibly improve contrast. After maximum clarity is achieved, apply the final rinse.

Developed impressions shall be photographed for preservation.

6.4 PRESUMPTIVE TEST FOR THE PRESENCE OF SEMEN

6.4.1 ACID PHOSPHATASE TEST (AP)

Acid phosphatase (AP) is an enzyme found at elevated levels in semen and at lower levels in some other biological fluids such as vaginal secretions. When the AP reagent is applied to the test sample, a purple color forms in the presence of AP activity. See the WSP Biochemical Analysis Procedures Manual for a description of the procedure to test for the presence of AP.

6.5 BIOLOGICAL EVIDENCE COLLECTION, PACKAGING, AND PRESERVATION

Biological evidence such as blood, seminal fluid, and saliva (even in minute amounts) and other body fluid stains can be vital information gathered by the crime scene analyst.

Universal precautions must be used in the handling of all biological materials, whether fluids or dried. Dry stains may flake when disturbed or collected, creating minute airborne particles which could be absorbed through the skin or mucous membranes (See Section 2 -- Safety above).

General principles of collecting and handling biological evidence at the crime scene include:

- Air-dry all biological evidence prior to submission to the laboratory
- Ensure that a stained area from an item of evidence does not come in contact with another item of evidence or another stained or unstained area
- Change gloves, as necessary, to avoid sample-to-sample contamination
- Prioritize the collection of biological evidence at the crime scene, ensuring the preservation of potentially fragile evidence
- Biological evidence should be packaged in paper (i.e. paper bags, swab boxes)

- If there is a danger of contamination due to saturation of items that cannot be air-dried prior to collection, the item(s) may be packaged in plastic and handed over to the requesting agency. Instruct the agency to air dry and re-package the item in paper at their facility as soon as possible
- If an item is sufficiently saturated with liquid blood or water, it may be transferred to the requesting agency unsealed, so long as this is documented in the notes and the requesting agency is instructed to seal the item as soon as practical.

Table 1 is a summary of collection methods and special considerations in handling biological evidence at the crime scene.

Table 1: Collection/Processing Methods and Special Considerations in Handling Biological Evidence

EVIDENCE	METHODS	SPECIAL CONSIDERATIONS
Wet Blood	Absorb a sample from the stain onto a sterile swab, saturating the swab, and allow the swab to dry in a swab box	
Dry Blood	Collect item, cut out the stained area, or collect the stained area onto a sterile swab moistened with deionized water.	
Latent Blood	Chemical enhancement helps visualize and enhance bloodstains including latent bloody footwear and friction ridge impression evidence.	Some processes, such as amido black, degrade DNA.
Semen/saliva/urine	An Alternate Light Source (ALS)/Forensic Light Source (FLS) may be used to locate a possible biological substance.	The recommendation of wavelength for biological substances is 430 – 515 with the use of orange goggles.
Physical Evidence from Sexual Assaults	Collect linens, towels, tissues, condoms, clothing, or fabric contacted by the suspect and/or victim.	Bedding and clothing may contain crucial evidence even when it has been washed.
Touch Evidence	Collect the item of evidence if possible or take a swabbing of the item with a sterile swab moistened with deionized water.	A wet swab followed by a dry swab should be used to collect touch DNA. This is especially useful for items that have been processed using cyanoacrolate.

The following are preferences for collection of biological evidence that should be considered in each instance of biological evidence:

- Collect the item on which the evidence is located
- When determining if the actual item should be collected, consider whether or not the item is of a reasonable size for packaging. If the item will not fit in the usual packaging container protect the area of interest with paper and collect the entire item. This may include things such as car seats, doors and other building materials
- Cut the evidence from its location
 - If collection of the item is deemed unreasonable, the next consideration is whether the evidence can be cut out of the item. This is a reasonable course of action when dealing with large furniture, area rugs and carpet, drywall, door and window frames, etc. Prior authorization should be obtained from the requesting agency before any cuttings are obtained. The item's orientation within the scene should be marked prior to removal so that in the future its original location can be determined. Package samples in paper products (bags, envelopes, etc.).
- Swab the evidence
 - Moisten a sterile cotton swab using deionized water to collect the sample. Concentrate limited samples on the tip of the swab. Always consider collecting multiple swabs if sample quantity permits. Swabs from the same location on the evidence should be packaged together to prevent the assignment of separate item numbers to the same sample. Label the container directly, even if the outer packaging will also be labeled.

Consult the WSP Forensic Services Guide for additional information regarding biological evidence collection.

7.0 BLOODSTAIN PATTERN ANALYSIS

Bloodstain pattern analysis is the examination of the physical nature of bloodstains to provide information specific to the events that occurred during the incident that created them. Further analysis in the laboratory can also help determine whose blood it is and, in cases where multiple people are bleeding, can be critical in terms of sequencing events.

Satisfactory completion of the Bloodstain Pattern Analysis (BPA) Training Curriculum is necessary for BPA in the field.

Prior equivalency may be substituted for all or part of the training with supporting documentation; however, a competency must be successfully completed prior to starting casework.

7.1 DOCUMENTATION OF BLOODSTAIN PATTERNS

Recording the orientation, location, size and position of bloodstains with respect to the overall crime scene through a combination of notes, diagrams, photographs, and the collection of the actual bloodstains is vital for their interpretation. Collection of the actual substrate containing the bloodstain pattern(s) is a valid method to supplement the documentation of this evidence.

A representative stain from any pattern considered to be bloodstains will be phenolphthalein tested for blood and the results of that test recorded in the notes.

Documentation guidelines described previously in this manual also apply for bloodstain pattern analysis. When documenting bloodstains, the analyst should (when applicable):

- Attempt to classify the pattern
- Measure the width and length of representative stains in a pattern, including directionality if applicable
- Measure the overall size of a pattern
- Record the location (measured to approximate center of pattern)
- Sketch the pattern to include the measurements of the stains and placement of the patterns on objects
- Roadmap the bloodstains and/or bloodstain patterns

Bloodstain pattern analysis on clothing or other fabric materials is best suited for examination in the laboratory. Wherever possible, collect the item (or portion of the item) for later analysis in the laboratory.

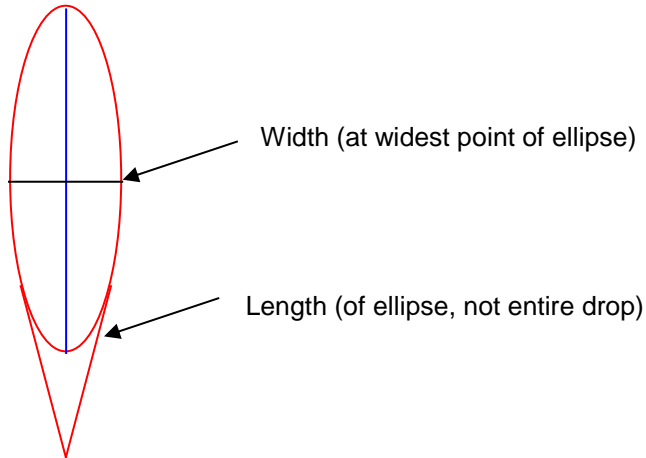
After a pattern has been fully documented (including photographs), collect a sample from a representative bloodstain(s) within the pattern for DNA analysis (when appropriate). Determination of which patterns are from separate events will be helpful in guiding sample collection.

7.2 ANALYSIS AND RECONSTRUCTION

Accurate descriptors of bloodstain patterns using standard terminology provide a valuable resource for post-scene analysis and later scene interpretation. Experimentation in a laboratory setting that is fully documented with notes, video, and/or photographs should also be considered when performing a reconstruction. Other documents to consider would be additional forensic laboratory reports, hospital and Medical Examiner reports, investigative supplemental reports, and witness statements. Anything used in a reconstruction must be documented in the case file.

7.3 BLOODSTAIN ANGLE CALCULATIONS

If a reconstruction requires impact angle determination of a bloodstain, or the area of origin of a blood source, use the following equations:



Calculating Impact Angle (θ)

$$\theta = \sin^{-1} (W / L)$$

W = width of stain

L = length of stain

Calculating Area of Origin

$$\tan (\theta) = H / D \text{ or } H = \tan (\theta) \cdot D$$

(θ) = angle of impact

H = height (distance) from target surface

D = distance to point of convergence

When calculating the Area of Origin on a vertical surface, care should be used when considering elliptical bloodstains exhibiting downward directionality as it may indicate that the stains have lost their acceleration and are now in a downward path influenced by gravity.

7.4 BLOODSTAIN TERMINOLOGY

The terminology used when documenting and reporting bloodstain patterns should follow a taxonomy approach. The notes must list characteristics to support the classification. The bloodstain terminology used is based on the definitions from the American Academy of Forensic Sciences Standards Board and can be found on the WSP Portal site. See [Appendix A](#) for bloodstain flow charts that can assist with the classification of bloodstain patterns.

8.0 BLOODSTAIN PATTERN ANALYSIS IN LABORATORY EXAMINATIONS

Bloodstain pattern analysis is the scientific study of the static consequences resulting from a bloodletting event(s). The role of a Bloodstain Pattern Analyst is to assist in the reconstruction of those events that could have created the bloodstains and bloodstain patterns at a crime scene or on items of physical evidence recovered from that scene. Information that may be obtained includes, but is not limited to: the relative position or locations of a victim and/or suspect at the time of bloodshed; the possible type of weapon used; the minimum number of blows struck; the sequence of bloodstain pattern events; the route taken by individuals during or after bloodshed; possible mechanisms that produced blood staining on clothing or other items.

8.1 REQUIRED TRAINING

The analyst should have a good background understanding of the various sections of the crime laboratory system to evaluate whether the bloodstain pattern examination will damage or change the evidence or if a supervisor/experienced analyst from another section should be contacted for advice about additional testing or sequence(s) of testing before handling the item.

The analyst will be familiar with proper note taking; evidence handling; safety concerns of evidence handling; legal aspects of evidence recovery; chain-of-custody requirements; storage of physical evidence; contamination prevention; and the significance of evidence analysis results, and report writing. Information on these topics can be found in the following manuals:

- Crime Laboratory Division (CLD) QOM
- Forensics Services Guide (FSG)

Satisfactory completion of the Bloodstain Pattern Analysis (BPA) Training Curriculum is necessary for BPA laboratory examinations.

Prior equivalency may be substituted for all or part of the training with supporting documentation; however, a competency must be successfully completed prior to starting casework.

Attendance at external courses/meetings regarding bloodstain pattern analysis is recommended.

8.2 EQUIPMENT, MATERIALS AND REAGENTS

The following equipment, materials, and reagents are recommended to perform bloodstain pattern laboratory examinations. Individual case circumstances may dictate additional requirements and modifications.

8.2.1 EQUIPMENT

Clean work surface
Tweezers
Rulers (ABFO, small rulers, etc)
Ruler and/or tape measure
Colored pens/pencils
Note taking materials
Digital camera with microscope mount capabilities
Infrared camera
Mini loupe or magnifying glass
High intensity lighting
Various alternate light sources with applicable goggles
Stereomicroscope with magnification ranges of at least 10x

Sterile cotton swabs
Filter paper
Appropriately scaled labels

8.2.2 PACKAGING MATERIALS

Envelopes
Evidence Tape
Marking pens
Glassine paper
Sterile collection materials

8.2.3 REAGENTS

Presumptive reagent

- Phenolphthalein reagent
- Hematrace® kit

Enhancement reagents

- Leuco Crystal Violet
- Amido Black
- Luminol
- Bluestar® Forensic
- Fluorescein

8.3 **EXAMINATION AND ANALYSIS**

8.3.1 CASE APPROACH

Review the Request For Laboratory Examination form and contact the detective/agency to obtain pertinent case information, specific information about the submitted evidence, and expected goals of the analyses. Depending on the case scenario, it may be useful to obtain crime scene photos, sketches, or other pertinent documentation from the submitting agency to assist in understanding where the submitted items were found. A review of the Medical Examiner's report and/or related emergency medical records is recommended.

Decide on the case approach and evidence prioritizations after the discussion with the agency and reviewing reference documents. Determine if multiple types of evidence are possibly present on the items such as fingerprints, other biological stains, etc. and plan to preserve that evidence for further analysis.

8.3.2 ANALYSIS AND NOTE TAKING

Describe and photograph the item, record the manufacturer information if it is present, and document damage. If pattern impressions are observed, an impressions analyst should be consulted.

Examine the evidence macroscopically to determine the characteristics of the bloodstains in a pattern. A stereomicroscopic search may also be required to further characterize individual bloodstains or locate very small bloodstains. Examine both both the interior and exterior sides of the clothing and describe the sidedness of the blood deposition, voids, and fabric folds within a pattern.

Describe the sizes, shapes, appearance, and locations of stains within the bloodstain pattern(s) using well defined and consistent terminology (refer to AAFS Standards Board: recommended terminology). Documentation by sketching and photographs is recommended. Describe the direction of spatter or

stain deposition, if possible, considering the item as it may have been used or worn during the incident.

Documentation by “roadmapping” (assigning major groups of stains a label such as “A” and individual stains within the group labels such as “A-1, A-2, A-3”, etc) is recommended when applicable. Detailed photographs of the patterns should be taken with scales. These photographs should include overall and close-up images. 3-dimensional analysis of the clothing may be required by an examiner donning the clothing or placing the clothing on a mannequin for 3-dimensional documentation.

At times, experiment(s) to duplicate the observed bloodstain pattern(s) may assist in establishing possible methods of deposition. These experiments should be conducted on a material that is similar in fabric composition and weave to the item in question.

8.3.3 REPORT WRITING

The report should list assumptions made, forensic reports, agency reports, autopsy reports and other reference documentation when used as the basis for conclusions. If any limitations to the analysis are present, they should be listed in the report.

Refer to the CLD QOM for general guidelines in report writing.

8.3.4 EVIDENCE PACKAGING

Package to ensure preservation of bloodstain pattern evidence.

Refer to the CLD QOM for proper packaging and preservation of the item.

8.3.5 QUALITY ASSURANCE

Take appropriate precautions when examining evidence to avoid contamination.

9.0 IMPRESSION EVIDENCE (FOOTWEAR, TIRE)

An impression may occur when an object such as a shoe or tire impresses or impacts a receiving object and characteristics or features from the impressing object are transferred onto the receiving object's surface.

Impression evidence may be fragile in nature and therefore consideration should be taken to document, collect, or preserve this evidence in a timely fashion. Any identified impression evidence should be protected so it is not destroyed or contaminated by personnel at the scene, weather, or other environmental conditions.

9.1 COLLECTION METHODS AND SPECIAL CONSIDERATIONS IN HANDLING IMPRESSION EVIDENCE

Photography, lifting, casting, and chemical enhancement are techniques that can help capture and preserve impression evidence. Take examination quality photographs of impression evidence before and after any casting or other collection or enhancement of impression evidence.

Case notes should have some statement(s) addressing the quantity and description of impressions located, along with which ones were cast, enhanced, and/or otherwise collected. This may be aided with sketches and photographs.

9.2 CASTING IMPRESSION EVIDENCE

Prepare the impression by removing any loose debris. Debris that may be embedded in the impression should be left in place. No material should be removed if there is any possibility of destroying any part of the impression by doing so. If needed, metal forms may be placed around the impression to contain the casting mixture.

If the impression is in sandy or loose soil, hairspray can be used to stabilize it. Avoid a direct application into the impression as the pressurized aerosol spray may disrupt the impression. Instead, mist the spray in the air space above the impression to allow the spray to fall into it.

Dental stone or similar commercially purchased casting products are recommended for casting impression evidence.

- Mix the casting material and water according to the manufacturer's recommendations. Adding the water to premeasured amounts of casting material in a plastic bag makes pouring the cast relatively easy
- Mix by kneading the bag until a uniform consistency similar to pancake batter is obtained and ensuring that all of the lumps are eliminated
- Generally, about two to three pounds of casting material is sufficient to cover an average size footwear impression
- If not using pre-measured bags of casting material, product can be mixed in an appropriate container such as a mixing bowl. Make sure enough is mixed to cover the impression in one application
- Casts are set in approximately 20 minutes to 2 hours depending on environmental conditions, the thickness of the cast, and the consistency of the original casting material

- Once set, carefully lift the cast by digging around the cast so that pressure is not applied to the cast itself
- Do not clean the cast; cleaning will occur in the laboratory
- Write or scratch an identifying mark on the back of the cast with a marker along with the date and initials of the analyst
- Package casts by wrapping with paper and place in a rigid container to ensure that the cast will not break. Be sure the cast is completely dry before packaging. Do not package in plastic

9.2.1 CASTING IMPRESSIONS ON CONCRETE

Occasionally, mud or soil impressions are observed on concrete. These impressions can sometimes be successfully lifted using a slight variation of the method described above.

Additional equipment: Duct tape

- Outline the area surrounding the impression with duct tape to aid in the release of the cast from the concrete
- Pour the casting material onto the impression assuring that it flows onto the tape
- Allow the cast to set
- Label the exposed surface of the cast with the appropriate markings
- Lift the duct tape to free the cast from the concrete
- Package as described above

9.2.2 CASTING UNDERWATER IMPRESSIONS

Impressions that contain a shallow amount of water may be cast using the procedure described in 9.2, but will use a mixture of casting material of slightly thicker consistency. The mixture will displace the thin layer of water.

Impressions that are completely underwater may still be cast.

- Do not attempt to drain any of the water as it may disturb the impression
- Place a metal casting form around the impression, taking care not to distort/disturb it – the top of the metal form should be above the water line
- Lightly sprinkle loose dry casting material over the underwater impression until the impression is covered by about an inch of material
- Mix additional casting material to a slightly thicker consistency than typical, and carefully scoop the mixture onto the impression. Allow to set for at least 60 minutes
- Label and package as described above

9.2.3 CASTING IMPRESSIONS IN SNOW

- Impressions that are in snow should be sprayed with at least 3 to 4 layers Snow Print Wax™ prior to casting, as it will preserve the detail. If Snow Print Wax™ is unavailable, spray paint may be used as an alternative.
 - Be careful not to hold the can of Snow Print Wax™ so close to the impression and at an angle that the aerosol damages detail in the impression.
- Be sure the entire impression is sealed with the Snow Print Wax™ or the casting material stone may seep through, causing damage.
- Allow to set for at least 10 minutes
- Cast the wax shell with a slightly thicker-than-typical cast material mixture
- Use cold water or some snow to help offset the exothermic reaction when mixing the casting material with water

9.3 IMPRESSION COLLECTION WITH GELATIN LIFTERS

Gelatin lifters can be used for the lifting of footwear and other impression evidence, marks in dust, and trace evidence. The thick, low-adhesive gelatin layer permits the lifting of trace material from almost every surface, including porous materials such as paper and cardboard.

Method

1. Choose the color of gelatin lifter based on which will result in the best contrast between the target impression and the backing color. Black often works well for impressions left in dust, while friction ridge detail developed with black fingerprint powder may best appear on a white background
2. Cut the gelatin lifter to a size just larger than the target impression
3. Label the back of the lifter with the orientation, item number, date and name or initials of person making the lift
4. Peel the protective transparent film away from the gelatin layer
5. Place one edge of the lifter, gel side down, on the impression and slowly smooth down the rest of the lifter over the impression, taking care to roll or press out any air bubbles. A roller may assist with this step
6. After the lifter has been smoothed over the entire surface of the impression, carefully pick it up, starting at the corners
7. With the gelatin layer up secure the lifter by the edges or corners onto the bottom of a flat, covered container such as a cardboard box to protect the exposed gelatin layer. Do not replace the protective film onto the gel
8. Take examination quality photograph(s) of successfully lifted impression(s)

Cautions

- The gelatin layer will melt between 40° and 45° Celsius (104° and 113° Fahrenheit). Objects that have been exposed to the sun which have reached these temperatures will need to be cooled before use
- Lifts may be stored at room temperature, though storage in a refrigerator is advantageous
- Attempts to lift dust prints on dirty backgrounds will cause both the dust print and dirty background to lift together. Subsequent lifts could be attempted to see if they would be successful

- Never slide the gelatin lifter across the surface with the impression
- If using a roller to eliminate air bubbles in the gelatin lifter, do so gently to avoid shifting or excessive pressure that may damage the impression
- Lifted impressions will fade and ultimately disappear over time. The rate of fading depends on storage temperature (cooler is better) and the material of the impression (e.g., silver fingerprint powders have lasted for several years without fading)

9.4 IMPRESSION COLLECTION WITH AN ELECTROSTATIC DUST PRINT LIFTER

The electrostatic dust print lifter (ESDL) is a device that creates a static charge on a lifting film, causing a dust impression to transfer from the substrate to the film. The device will work on both porous and non-porous substrates; however, they work best on dry dust impressions on relatively clean surfaces. The technique is not successful with wet transfers or dry transfers that became wet or damp prior to lifting.

As a precaution, the electrostatic dust print lifter should not be operated by persons with pacemakers.

Method

Examination quality photograph(s) of the impression should be taken prior to any lifting attempts

9. Position the grounding device and attach the ground wire of the unit to the ground plate (or other grounding material) with maximum contact to a surface adjacent the impression surface
 - a. For impressions on moveable objects, such as newspapers, rugs, etc., the best position for the ground plate would be under the impression with the metal side up
 - b. For impressions on immovable objects, such as a floor or wall, place the ground plate (metal side down) or the metal antenna next to, but not touching, the object
 - c. For impressions on metallic objects, such as a vehicle door, the ground wire may be attached directly to the metallic object
10. Place clean lifting film over the impression
 - a. The film has two sides: a metallic silver side and a black side. The black side should be facing the impression (face down) and the silver side away from the impression (face up)
 - b. The lifting film must be larger than the impression to ensure a full transfer (it is prudent to use a larger piece than expected especially with latent or partial prints, as more detail may be present that is not apparent to the unaided eye)
11. Mark the orientation of the film
12. Place the probe on a corner of the metallic surface of the lifting film and turn on the voltage. Start at a lower voltage setting, and increase voltage as needed
 - a. It is not necessary to move the probe around the film. If any air bubbles develop as the film adheres to the substrate, they may be rolled out with a clean fingerprint roller
13. After the power is turned off, let the probe stay in contact with the film for at least 5 seconds to allow the static charge to dissipate and avoid receiving an electric shock

14. Remove the film, turn over, and evaluate with the unaided eye. If nothing is visible, the film must be examined in a darkened room with oblique light to evaluate the success of the lift. **Never discard a lift without careful examination.**
15. Subsequent lifts may be performed if the first lift resulted in a large quantity of undesired transferred material
 - a. Second or third lifts may yield a “cleaner” impression as interfering background material may have been reduced during the first lift
 - b. Lifts with an overall lack of transfer will not be successful in subsequent lift attempts
16. Take examination quality photographs of successful lifts.
17. A successful lift must be retained by securing it to prevent movement or destruction of the lift.
18. Label the back (top surface) of the lift with CLD required markings.

Case notes must have some statement(s) addressing the quantity and description of impressions located, along with which ones were lifted. This may be aided with, but not replaced by, photographs.

Cautions

- Not all dry impressions can be successfully lifted using ESDL
- It is possible to receive electrical shocks from the lifting film, the ground plate, the metal probe, and a metallic impressed surface. Such shocks will be avoided by not touching any of these parts when the current is on and by allowing the probe to discharge after use
- Do not allow the lifting film to come into contact with the grounding plate while the ESDL is on – this will cause arcing and the device will not work properly
- If arcing occurs between the film and the ground, the power is too high or part of the film is touching or too close to the ground plate
- Attempts to lift dust prints on dirty backgrounds will cause both the dust print and dirty background to lift together. Subsequent lifts should be attempted to see if they would be successful
- Never slide the lifting film on the impression surface

9.5 IMPRESSION COLLECTION WITH STATIC LIFTERS

Vinyl static cling films (static lifters) such as the Stat-Lift™ can be used to lift footwear and other impression evidence made of fine materials such as dust on most substrates.

Method

- Choose the appropriate color and size of the static lifter for your impression evidence.
- Peel the static lifter off the backing and carefully place over the impression(s). You may tape the lifter in position to stabilize it.
- Label the back of the lifter with the orientation and other appropriate case information.
- Apply thorough and even pressure across the lifter to transfer the impression. You may use a roller for this step.

- Remove the lifter from the impression and place on a flat surface with the dust side up.
- Take examination quality photograph(s) of the lifted impression(s).
- Cover with backing or paper and tape the cover in place.
- Package in an appropriate container.

9.6 IMPRESSION COLLECTION WITH ADHESIVE LIFTS

Large adhesive sheets can be used to lift footwear and other impression evidence made of fine materials, such as dust on a nonporous substrate.

Method

- Remove an adhesive sheet from the backing and carefully place it over the impression.
- Apply thorough and even pressure across the adhesive sheet to transfer the impression to the sheet.
- Remove the sheet from the impression substrate and transfer it sticky side down onto transparencies.
- Label the adhesive lift with the impression orientation and other appropriate case information.
- Package in an appropriate container.

9.7 MAKING EXEMPLAR TIRE IMPRESSIONS

9.7.1 ROLLING METHOD

Exemplar prints must be taken while the tires are on the vehicle. If they have already been removed, place them on a similar vehicle before making exemplars.

1. The tires may need to be wiped down with heavy work gloves or rags to remove any surface debris. Be careful not to dislodge rocks that may be embedded in the tread. If appropriate, collect soil/material that is adhering to the vehicle for comparison to soil/material at the scene. Note: The material on the tires is likely not of value; however this may be case dependent and should be discussed with the requesting agency's investigator if necessary.

The best surfaces will be asphalt or concrete. Be sure the surface is swept to remove as much debris as possible.

2. Start with cardstock or art board or similar type material that is about 4 – 6 inches longer than the measurement of the circumference of the tire. The typical length of cardstock needed for a passenger vehicle tire is approximately 8 feet.
3. Place the cardstock in front of the tire. It does not matter if you start with the front or back tires first. Adhesive tape can be used to attach the separate lengths of cardstock together.
4. Mark each tire with tape, chalk, or other form of visual identifier on at least 4 points equidistance around the tire and label each section, such as 1, 2, 3 and 4.
5. A picture can be taken to record the approximate location of these marks in relation to the side labels. This will help in the comparison process.
6. When processing the front tires, ensure the back tires do not run over the cardstock used in the processing of the front tires.

- a. After the tire has been cleaned, use a shoe polish sponge or gloved hand that has been loaded with a silicone spray or petroleum jelly to spread over the entire surface of the tire tread. Slow drying black spray paint or black fingerprint ink may be used as an alternative and once rolled will not need magnetic fingerprint powder application.
 - b. The vehicle will have to be rolled forward to finish spreading over the portion of the tire that was in contact with the ground.
 - i. Roll the car onto the cardstock.
 - ii. Mark the closest point on the cardstock that comes into contact with the card first.
 - c. Hand push the car over the cardstock.
 - d. Note the proper sequence on the cardstock as the tire passes over each (i.e. 1st, 2nd, 3rd).
7. Write the tire (front/back, passenger/driver), direction the tire was rolled, date, case number, etc, on each section of cardstock before removal.
 - a. Record in your notes, on the cardstock, and/or photography, the following: make, model, and size.
8. Develop the impression by using magnetic fingerprint powder only. Regular powder with a regular brush will damage the impression.
9. A clear acrylic lacquer may be sprayed over the processed impression and allowed to dry.
10. Package with paper to protect each processed impression.

When all exemplars are completed, discuss with the requesting agency's investigator about collection of the tires for comparison.

If a comparison of the tire against a questioned impression at a scene is required, the tires must be submitted.

9.7.2 WET MEDIA METHOD

1. Wipe tires down to remove any surface debris. Be careful not to dislodge rocks that may be embedded in the tread.

The best surfaces will be smooth, dry asphalt or concrete. Be sure the surface is swept to remove as much debris as possible.
2. Roll out enough paper to keep tires on them after rolling
3. Measure the tire circumference.
4. Measure the wheel base.
5. Mark and label ~ 4 equidistant points (including the valve stem) on the sidewall.
6. Lay out 2 sections of firm paper board (each are at least the length of the tire circumference) end on, in front of the tire; the first one will serve as an "ink pad", lay out clear wet media film on the second
7. Apply black oil-based block printing ink in a very thin film using a roller such as a fingerprint roller.

8. Push the vehicle onto the ink pad and then onto the film, mark the location of the sidewall labels as they contact the wet media film
9. Mark the exemplar with information about the tires and direction of travel
10. Allow to dry, may take 4-6 hours depending on the environment

If the exemplars do not reflect sufficient tire tread details, prepare additional exemplars.

Once dried the wet mount can be rolled up and packaged appropriately.

When all exemplars are completed, discuss with the requesting agency's investigator about collection of the tires for comparison.

If a comparison of the tire against a questioned impression at a scene is required, the tires must be submitted.

9.8 MAKING ADHESIVE LIFT EXEMPLARS OF TIRE TREAD AND SIDEWALL PATTERNS

Adhesive tire tread and sidewall lifts may be taken to document the design pattern that continues from the tread onto the sidewall of the tire. These lifts can be used by the impression examiner for exclusionary purposes.

Method

- Remove surface debris from an area of the tire tread including both sides of the adjacent sidewalls.
- Dust the tread and sidewalls with black fingerprint powder or a suitable substitute if there is not enough residual dirt on the tire.
- Remove an adhesive sheet from the backing and carefully place it over the dusted tread and sidewalls.
- Apply thorough and even pressure across the adhesive sheet to transfer the powder from the tread/sidewall design to the sheet.
- Remove the sheet from the tire and transfer it sticky side down onto transparencies.
- Label the adhesive lift with the tire information, orientation, and other appropriate case information.
- Package in an appropriate container.

When all exemplars are completed, discuss with the requesting agency's investigator about collection of the tires for comparison.

If a comparison of the tire against a questioned impression at a scene is required, the tires must be submitted.

10.0 FIREARMS EVIDENCE

Safety is the first consideration when collecting firearms evidence from the crime scene. When possible, general documentation of the firearm should be taken of all sides and markings prior to moving or rendering the firearm safe. Careful attention to the position of any safeties/hammer/etc. of the firearm should also be documented.

10.1 COLLECTION AND DOCUMENTATION OF FIREARMS

The following are general principles and methods associated with collection and preservation of firearms at the crime scene.

- Fragile or easily lost trace evidence (i.e., hair, fibers etc.) observed on firearms should be removed and collected separately
- Any evidence with possible blood or body fluids should be air-dried if possible, then packaged in paper bags, envelopes, or cardboard boxes
- Do not attempt latent print, or other evidence processing at the scene
- Photograph the item before it is moved
 - If the firearm has been moved and rendered safe before CSRT arrival at the scene, a note should be made as to its reported original position, condition, any associated ammunition components, the order they were removed along with the name of the individual who reportedly moved it if available
 - If the firearm is rendered safe by agency personnel other than CSRT at the scene, a note should be made as to its reported condition and orientation, any associated ammunition components, the order they were removed, and who made the firearm safe (if known)
 - Record markings and photograph if possible (serial numbers, make/model, etc)
- Once photographed in its as found position, photograph from all sides
- Never move a firearm by inserting any object inside the barrel or trigger guard. This is unsafe and can damage potential evidence
- Document the headstamp of any ammunition associated with the firearm (may not be necessary for loaded magazines)
- If the firearm is a revolver, the position and type of ammunition or fired components should be documented
- The firearm should be unloaded taking care not to destroy any latent, trace, blood, or other evidence
 - When possible, do not cycle the action when unloading the firearm
 - If the weapon cannot be made safe, the packaging should reflect this
 - If the requesting agency or an officer on scene makes the firearm safe, a note should be made as to its initial condition, any associated ammunition components, the order they were removed, and who made the firearm safe
- When possible the firearm should be secured with the action open and packaged in a way to demonstrate that the firearm is safe

- Zip-tie the action open (e.g. hammer to the frame or between the hammer and frame, run a zip-tie down the magazine well)
- The firearm can now be secured in a box for collection
- Package firearm in a rigid container (gun box), seal, mark container, and indicate condition as LOADED or UNLOADED
- If the weapon cannot be made safe and is being submitted to the lab, the firearm shall be hand carried by the investigating agency to the lab

Special Considerations

- Firearms found in water
 - Place the firearm in a container of the same water from which it was recovered and submit the item immediately
 - Leaving a firearm in the same water in which it was found will slow the rusting process

10.2 COLLECTION AND DOCUMENTATION OF FIRED COMPONENTS

All bullet fragments should be collected when practical, unless their collection might cause too much damage to the structure the bullet or fragments are imbedded in, or the agency requesting assistance from CSRT refuses it. Any reason for not collecting all of the bullets or fragments will be documented in the notes

- Bullets, shotshell wads, shot pellets, and slugs should be packaged separately. A Kimwipe or other tissue may be included in the package to prevent excessive contact with the packaging material
- Cartridges, cartridge cases, and shotshells should be packaged separately. A Kimwipe or other tissue may be included in the package to prevent excessive contact with the packaging material
- Recover any unused ammunition from the scene of the same brand and type as was found in the firearm or at the scene for potential laboratory examination

10.3 CHEMICAL TESTING OF BULLET DEFECTS

Chemical testing is used to determine if a hole or ricochet mark is the result of the passage of a bullet or a bullet impact. Suspected bullet defects must be tested for the presence of copper, or lead or both when possible. These are the primary components that comprise a bullet. Locations of potential bullet defects may prohibit chemical testing (i.e. if a bullet defect is high up on a building).

If choosing to test for copper in addition to lead, always test for copper first.

A known positive and negative control will be tested prior to use each day. This quality control check will be documented in the case notes.

A positive test for lead or copper permits a defect to be identified as consistent with the passage of a bullet or a bullet impact.

A negative chemical reaction for lead or copper does not necessarily mean that a defect was the result of something other than a fired bullet. The type of substrate, composition of the bullet, and the size of the defect may affect the chemical color tests and should be noted.

10.3.1 DITHIOOXAMIDE (DTO) TEST FOR COPPER

Procedure

- Moisten filter paper or Bench Kote® with the ammonia solution
- Apply moistened paper directly to the surface to be tested (do not rub) maintaining contact for approximately 30 seconds before removing
- Apply DTO solution to the moistened paper

Result

A green/gray color reaction indicates a POSITIVE reaction for the presence of copper

10.3.2 2-NITROSO-1-NAPHTHOL (2NN) TEST FOR COPPER

Procedure

- Moisten filter paper or Bench Kote® with the ammonia solution
- Apply moistened paper directly to the surface to be tested (do not rub) maintaining contact for approximately 30 seconds before removing
- Apply 2NN solution to the moistened paper

Result

An orange color indicates a POSITIVE reaction for the presence of copper

10.3.3 SODIUM RHODIZONATE (NaRho) TEST FOR LEAD

Procedure

- Moisten filter paper or Bench Kote® with the acetic acid solution
- Apply moistened paper directly to the surface to be tested (do not rub) maintaining contact for approximately 30 seconds before removing
- Apply NaRho solution to the moistened paper
- A dark purple color with an orange background may appear (constitutes a positive reaction)
- Optional - Apply the 5% HCl solution to the developed purple area

Result

The orange color background should clarify and the purple change to purple-blue to confirm the presence of lead.

10.4 TRAJECTORY DOCUMENTATION

Method

The following guidelines should be used when documenting trajectory evidence and determining a trajectory:

- The bullet hole/defect(s) should be properly photographed; note the shape and any impact features (and collect when appropriate)
- Measure the hole/defect (this may be the only estimate of angle)
- Document the location of the bullet hole/defect in your notes (sketch, measurements, etc.).
- If applicable, collect trace evidence from the hole/defect
- If possible, determine if the defect is an entrance or exit point and look for corresponding re-entry points
- Test defect for the presence of copper or lead or both
- Using the trajectory kit:

- Carefully place a trajectory rod through the entrance hole (and associated exit hole, if applicable).
- If necessary place a cone shaped centering guide on the rod and gently guide the tapered end into the entrance hole. A rubber o-ring may be used to hold the guide in place. Use a second centering guide for the exit hole, if necessary.
- Hand measuring trajectories:
 - Place the angle finder along the top of the trajectory rod and record the measurement of the vertical impact angle relative to the horizontal plane.
 - Alternatively, a protractor may be used to determine the impact angle.
 - With the protractor in a vertical position, place the center of the flat edge flush with the center of the bullet hole.
 - From a 90° angle (side-view), determine the vertical impact angle. It is important to document whether the measured angle is in relationship to the target surface or the horizontal plane (see example below).
 - This must be documented by a description and/or a sketch.
 - With the protractor in a horizontal position, place the center of the flat edge flush with the center of the bullet hole.
 - From a 90° angle (top-view), determine the horizontal impact angle. It is important to document whether the measured angle is in relationship to the target surface or the vertical plane (see example below).
 - This must be documented by a description and/or a sketch.
 - A laser can be attached to the end of the trajectory rod to project/extend the trajectory in either direction.
 - The trajectory determination shall be photographed with trajectory rods, strings, and/or a laser and photographic fog, as appropriate. The analyst must be cognizant of the effect that the placement of the camera in relationship to the trajectory will have on the resulting photograph (the trajectory can appear skewed due to the angle and level of the camera).
- Measuring trajectories with a High Definition Surveyor:
 - Only a survey grade (Cxx or Pxx series) scanner may be used to measure trajectories. Imaging scanners such as the BLK360 may not be used to measure trajectory angles.
 - Level the scanner and ensure that it maintains level throughout the scan process.
 - Position the scanner relatively close to the trajectory rod (within 10m) to be measured and in an orientation that allows the majority of scan measurements to be taken along the length of the trajectory rod(s).
 - Detail scans of each trajectory rod should be captured with a resolution setting of 1.6mm at 10m.

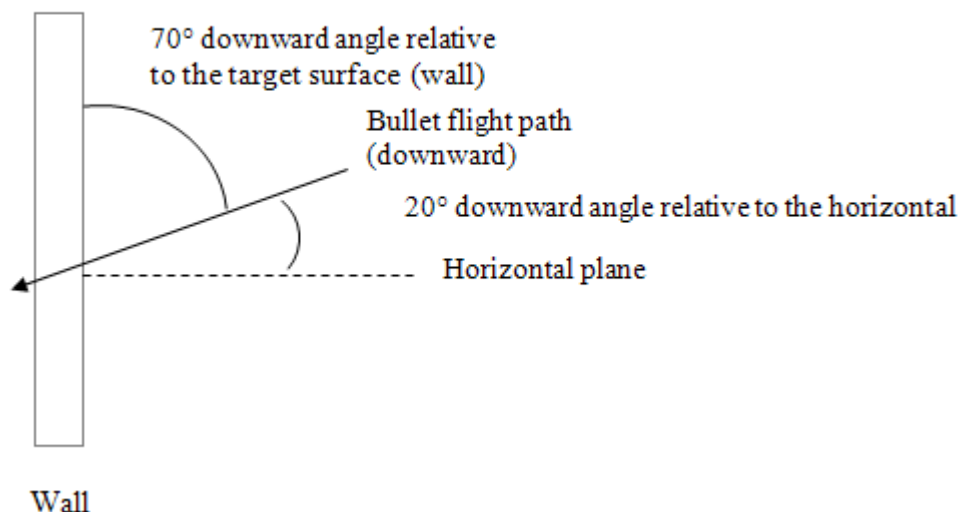
Washington State Patrol Crime Laboratory Division
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- Each trajectory rod should be scanned in one ScanWorld location only. After detail scans of each trajectory rod are captured, the rods should be removed.
- Elevation and azimuth trajectory angles will be measured in Cyclone® software

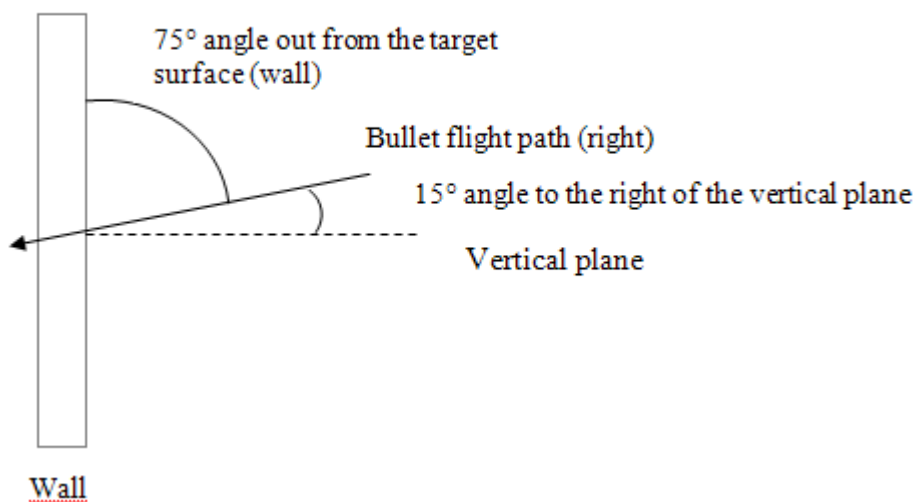
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EXAMPLES OF TRAJECTORY DOCUMENTATION

SIDE-VIEW OF WALL



TOP-VIEW OF WALL



10.5 DISTANCE (PROXIMITY) DETERMINATION

The entrance point of a bullet trajectory should be examined for gunshot residue. If a pattern is detected or thought to be present, the item or area should be documented and photographed. If the item can be collected, it should be carefully preserved to prevent damage or disruption to powder residues deposited around a bullet hole or the shotgun pellet pattern. The cutting or tearing of the item in the area of the holes must be avoided when the item is being removed. If the item is clothing from the victim, then each item of clothing should be packaged separately to protect from cross-contamination. Obtain permission from a Medical Examiner or Coroner prior to collecting clothing from decedents on scene. For shotgun pellet patterns the same process should be followed.

10.5.1 SHOTGUN PELLET PATTERNS

The total shotgun pellet pattern should be fully documented to include photographs with scale as well as the general size and location of the pattern.

The discharge of a shotgun against a flat surface other than 90 degrees will produce an elliptical pattern. The approximate angle of incidence can be calculated by dividing the minimum diameter by the maximum diameter of the elliptical pattern and then using the arcsine function to obtain the incident angle. It should be noted if any "flyers" (outliers) are included or excluded when determining the incident angle.

A few samples of the shot should be collected from the pattern.

11.0 TOOLMARK EVIDENCE COLLECTION

A toolmark is any impression, scratch, gouge, cut or abrasion made when a tool is brought into contact with an object, leaving a mark and should be documented like other impression evidence. Toolmark evidence may be present at various types of crime scenes, from burglary to homicide.

11.1 TOOLMARK TERMINOLOGY

The following definitions are used in the discipline of toolmark identification:

Tool: The harder of two objects, which when brought into contact with another object results in the softer object being marked by the harder one

Toolmark: The mark produced on the softer of two objects by a harder object coming into contact with it

Cast: The reproduction of a toolmark or the surface of a tool made with a molding material such as silicone rubber or Forensic Sil™

11.2 GENERAL PRINCIPLES OF TOOLMARK EVIDENCE COLLECTION

Below are some general principles and methods of toolmark evidence collection and crime scene analysis:

- Never place a suspect tool into a toolmark as it could destroy markings or transfer trace evidence
- Collect the toolmark evidence for laboratory analysis, if possible, rather than creating a cast at the crime scene
- Depending on the security situation and potential damage to property, toolmarks on large objects might be cut out
- Protect the toolmark area by covering it carefully before packaging as appropriate
- The use of a soft brush or compressed air may be helpful to remove dirt before casting a toolmark as casts will duplicate foreign material in the stamped characteristics
- Fully document (notes, photographs, sketches as appropriate) potential toolmark evidence
- Consider that friction ridge examination and/or DNA analysis may be needed on a suspected tool
- Package tools in a manner to protect the working end of a tool
 - If friction ridge impressions are of interest, immobilize the tool to reduce contact with packaging material
- Recover shavings or any other possible debris associated with the tool and/or toolmark
- Package broken parts (tools, belts bolts, knives, screwdriver blades, etc.) to be examined in a manner that protects the edges of the items to be fracture matched

11.3 CASTING TOOLMARKS

Forensic Sil™, or similar silicone rubber casting material, is available in various colors (including brown, white, black and, clear) and can be used to create a reproduction of toolmark impressions.

Document the Impression

A photograph of the area to be cast should be taken in a manner that shows the impression in relation to its surrounding. Additional close-up photographs that provide detail of the impression should also be taken with scales. The location where each cast was recovered should be documented in the written notes.

Preparation

Use casting material in accordance to manufacturer's recommendations.

Packaging

Package casts separately, in a small box or envelope, or in such a manner that multiple casts do not come into contact with each other.

12.0 LATENT PRINT AND FRICTION RIDGE IMPRESSION EVIDENCE

Latent prints can be divided into two categories:

- **Invisible prints** - those made by perspiration and other substances on the skin surface and which require development by physical or chemical methods
- **Visible prints** (Plastic/Patent) - those made in soft pliable substances such as putty, modeling clay, etc (Plastic), and those made by contamination of the skin with such substances as blood, paint, ink, etc (Patent)

12.1 LATENT PRINT RECOVERY

Where possible, individual evidence items that require latent print processing should be collected for analysis in the laboratory.

The crime scene analyst shall make the following considerations in determining the processing sequence for each item or surface to be processed on-scene:

1. Generally, move from the least invasive technique to the most invasive technique
2. Consider the surface of the item (porous, semi-porous, or non-porous) to establish suitable processing techniques
3. Consider the color of the surface to determine which technique will provide suitable contrast for the detection of impressions
4. Consider the texture of the surface to determine whether developed impressions will require imaging for preservation. In such a case, use a technique that will provide the best contrast
5. Consider which matrix (sweat, blood, dirt, oil, amino acids, lipids, etc) may have been deposited or will best be developed on the surface of the item
6. Avoid techniques which may compromise other forensic analyses which may be required

A visual examination shall follow each technique employed. Some techniques may require the use of an ALS for examination. Impressions that are suitable for further analysis shall be preserved via lift or digital image once detected and also if enhanced in any way by subsequent techniques. If the analyst is unsure of the suitability, preserve the print for further analysis by the Latent Print Section.

12.2 PROCESSING GUIDELINES

The aforementioned considerations will work in conjunction with the following general processing sequence guidelines to allow the analyst the flexibility to determine the best course of action. Some of the following techniques are beyond the scope of the CSRT Training Manual and require additional documented training prior to use at a crime scene,

Non-Porous Surfaces: substrates that do not absorb the latent print residue, (i.e. glass, metal, plastic)

1. Visual examination
2. Cyanoacrylate*
3. Powder processing and/or dye stain (not necessarily in that order)

If a print is contaminated with blood, use Amido Black or Acid Yellow 7 after processing the surrounding surfaces with powder.

Semi-Porous Surfaces: substrates that may absorb some of the latent print residue (i.e. some treated wood or cardboard)

1. Visual examination
2. Cyanoacrylate*
3. Powder processing

*Cyanoacrylate processing may not be necessary or feasible, depending on the nature of the scene and evidence. Recently deposited impressions may not require cyanoacrylate processing before powder processing. Also, large objects (exterior of vehicles, windows, etc.) might not be conducive to safe, effective cyanoacrylate processing.

Porous Surfaces: substrates that absorb the latent print residue (i.e. paper, untreated wood, cardboard).

In most cases, porous items should be collected at the scene for processing in the laboratory.

Adhesive Surfaces (i.e. tape, stamps)

In most cases, adhesive items should be collected at the scene for processing in the laboratory.

Items with Biological Contaminants

In general, the item may be visually examined, fumed with cyanoacrylate, and dusted with a clean powder and brush prior to swabbing or packaging the item for DNA analysis. Developed impressions should be photographed and not lifted if the same area requires DNA analysis. Chemical reagents or techniques that require a wash may be completed after the biological evidence has been collected. If needed, consult with the appropriate regional DNA and latent print sections to determine sequencing order for any item possibly contaminated with blood or other biological contaminants.

12.3 DOCUMENTATION OF FRICTION RIDGE IMPRESSION EVIDENCE

A description of the evidence item(s) as well as all examinations, pertinent observations, and results shall be documented in the analyst's case notes.

Record the sequential order of the processing techniques used. If the evidence is not processed in accordance with the above general processing sequence guidelines, document the variance and the reason.

Throughout the sequence of processing, any impressions deemed suitable for further analysis will be preserved prior to any additional processing techniques. Case notes shall indicate the item and/or location from which each lift and/or photograph was generated from. Digital image file numbers for each examination quality image will be recorded in the notes.

12.4 COMMON PROCESSING TECHNIQUES FOR CRIME SCENES

12.4.1 AMIDO BLACK

Amido black is an enhancement technique for use on faint, bloody impressions and is especially useful for nonporous surfaces, such as glass, plastic, and vinyl. It reacts with proteins present in blood and results in a blue-black color, typically increasing the contrast of the impression on the substrate.

12.4.2 CYANOACRYLATE ESTER (SUPERGLUE) FUMING

Fuming with cyanoacrylate will cause latent print residue on non-porous and some semi-porous surfaces to sometimes appear white in color. Latent prints developed this way are not easily damaged. See the **Latent Prints Technical Manual** for a description of the procedure for conducting superglue fuming.

12.4.3 POWDER PROCESSING

Powder development techniques are used to develop friction ridge skin impressions on non-porous and semi-porous items. Powder development makes friction ridge detail visible and improves the contrast of already visible detail. This development technique facilitates preservation via imaging and lifting the impression. See the **Latent Prints Technical Manual** for a description of the procedure for powder processing.

LIFTING TECHNIQUES

When using lifting tape to remove a developed friction ridge impression, care should be taken in unrolling the tape from a roll so that hesitation creases do not occur. The unrolling should be performed in one smooth, continuous action.

The application of the lifting tape (or other lifting device) to the surface should also be in one smooth motion. The tip of a gloved finger or a rounded object may be pressed to the tape during application to preclude air bubbles and to ensure good contact with the lifting surface. Some bubbles can be eliminated effectively (without damaging the friction ridge impression) by applying pressure with a gloved finger (or other smooth, rounded object) to force the air pocket out at the edge of the tape. The lifting of the friction ridge impression away from the surface should also be in a smooth continuous motion.

The lift shall be marked with the following:

- Date of lift
- Location of lift
- Name or initials of person making the lift
- Unique lift number

A diagram of the lift location on the object is recommended. An arrow indicating the direction of the lift is also valuable for determining the orientation of the impression(s) and how an object was touched or handled.

Any latent impressions appearing on the perimeter of the lift, deposited by the individual making the lift, shall be crossed-out and initialed.

12.4.4 SMALL PARTICLE REAGENT

Small Particle Reagent (SPR) is a suspension of fine Molybdenum Disulfide particles in detergent solution. This process can be used on wet, or previously wet, non-porous surfaces. SPR adheres to fatty constituents of latent prints to form a gray deposit. See the Latent Prints Technical Manual for a description of the procedure for small particle reagent.

12.5 **DEVELOPING LATENT PRINTS ON HUMAN SKIN**

AMIDO BLACK:

Amido black can be used to enhance latent prints contaminated with blood on a cadaver. The standard technique for amido black should be used.

LIFT TRANSFER METHOD:

For live victims, a piece of black plastic or RC photo paper developed as black can be held against areas suspected as possibly bearing latent prints. Other nonporous surfaces such as a mirror, glass, or metal plate may be used instead of photo paper. A sponge or soft pad should be placed between the analyst's hand and the photo paper to improve contact with the victim's skin.

Hold the transfer surface against the skin for 15 to 20 seconds. The nonporous transfer surface should then be cyanoacrylate fumed to develop any friction ridge detail that may have transferred. Condensation on the body is acceptable as any water in the latent print residue will aid polymerization with cyanoacrylate fumes.

After cyanoacrylate fuming, further development of the nonporous transfer surface should include luminescent dye stain, alternate light source excitation, and (lastly) powder rubbing.

For deceased victims, the body's skin surface should be between 72 and 80 degrees for optimal fatty/waxy impression transfer. Warm the lift card or other transfer medium just before lifting.

CYANOACRYLATE FUMING CADAVERS:

Ideally, the body should not be refrigerated prior to fuming because moisture can destroy impressions that might otherwise be developed. If already refrigerated, permit all condensation moisture to evaporate upon removing the body from the cold locker/drawer.

An airtight plastic tent can be assembled over the body and fumed with cyanoacrylate. A small, battery powered fan may be used to help with fume distribution.

After fuming, dust the body using a contrasting color powder. Developed impressions shall be imaged for preservation.

13.0 TRACE EVIDENCE

Trace evidence analysis is, in part, based on Locard's Principle of Exchange where an individual or object leaves behind and/or picks up traces of materials from another person or an environment, however brief and slight the contact.

Types of trace evidence can include, but are not limited to, impressions from footwear and tires, soil, building materials, vomit, glass, fracture matches, hairs, fibers (including fabric and cordage), paint, primer residue, vehicle lamps, explosives, and general chemical unknowns.

13.1 GENERAL PRINCIPALS AND METHODS

The following general principals apply to identification, collection, and processing of trace evidence from the crime scene:

Trace evidence may be either visible or not visible to the naked eye. Some things to consider may be:

- There are a wide variety of methods available for collecting trace evidence which will be dependent on a number of variables including the nature of the crime scene, established priorities for evidence collection, evidence type, and substrate type
- Avoid using tools that are difficult to clean thoroughly and keep contamination-free such as serrated tools
- It is important to collect an adequate number of samples of many types of trace evidence to ensure the ability of the laboratory to account for variations in characteristics from one area or region of an object to another
- For items such as glass, carpet, paint, etc, take a control sample from an unaffected area to have for comparison, should it be necessary
- In labeling trace evidence, it is important to identify the region(s) of an object from which the trace evidence was obtained, provide a narrative identifying other trace evidence that may or may not be present in the same region, and utilize photography protocols that adequately describe the content and context of trace evidence

13.2 GENERAL DETECTION, COLLECTION AND PRESERVATION TECHNIQUES FOR TRACE EVIDENCE

Techniques and procedures for finding, collecting, and preserving trace evidence at the crime scene will vary in each situation. Variables to consider include the nature of the crime scene, ambient conditions, the need to preserve or collect other types of evidence, and the discriminatory power of the different techniques.

Analyst's notes should include descriptors of the techniques used for collecting and preserving trace evidence.

Trace evidence can be detected using:

- General visual searches
- Searches enhanced by different types of illumination such as ALS and/or oblique lighting
- Visual searches enhanced by magnification

Collection techniques include, but are not limited to:

- Lifting: An adhesive-bearing substrate such as tape is firmly patted or rolled onto the item, causing loosely adhering trace evidence to stick to the tape. The tape is then placed onto a sheet protector or transparency to protect and preserve the trace evidence.
- Picking: Trace evidence is separated from an item using clean gloved fingers, clean forceps, or other hand implements. Avoid using implements with serrated edges
- Cutting: Stains and materials firmly adhering to a substrate (such as fabric) can be removed by cutting, using clean scissors or any clean sharp bladed tool
- Scraping: A clean spatula or similar tool is used to dislodge trace evidence from an item onto a collection surface

Collection methods and special considerations for handling trace evidence are summarized in Table 2.

13.3 GLASS

Glass evidence may be relevant to a number of different categories of analysis including:

- Identification of material as glass
- Fracture matches of glass
- Comparison of questioned glass particles to known glass samples
- Point of impact determination
- Direction of impact determination
- Sequence of impact determination

13.3.1 GENERAL PROCEDURES FOR GLASS

- Adhesive material such as clean post-it notes can be used to collect glass samples
- Collect samples of all broken glass sources on the scene including samples from all panes of a multi-paned window
- All questioned items should be packaged separately from known broken glass sources
- With tempered glass, recover as many larger-size pieces as possible when point of impact, direction of impact, or sequence of impact analysis is required, since this type of analysis can only be done on tempered glass through reconstructing the broken pane
- Microscopic analysis of clothing and other items may reveal glass trace evidence that is not visible to the naked eye. In crime scenes where glass was broken and clothing

recovered, clothing may be submitted even though glass particles are not readily visible

13.3.2 GLASS FRACTURES

Window glass is manufactured in different ways to provide various features with different levels of safety. Flat glass refers to normal window glass that is annealed and typically breaks with very sharp edges and pointed fragments. Tempered glass (sometimes called safety glass or toughened glass) has been manufactured in a way that makes the glass more resistant to breakage and, when broken, will break into small cubical fragments. Laminated glass is two layers of glass bonded together with a thin plastic layer. The glass used in laminated windows can be annealed or tempered.

Based upon the type of glass that is broken, it may be possible that some determinations may be made as to the type of force that produced the break, where the breaking force was applied, the direction of force that broke the glass and the sequence in which multiple forces were applied.

13.3.2.1 Determination of Breaking Forces

Thermal Fractures

Thermal fractures are characterized by the wavy appearance of the fractures that occur in window panes. Additionally, the fractured edge surface will typically appear as a mirror finish. These characteristics can readily distinguish fractures produced by the heat of a fire from those fractures produced by mechanical force.

Mechanical Fractures

When an annealed glass windowpane is fractured by an applied force, characteristics are produced in the fractures that are indicative of the location and direction of the force that produced the break.

- Identify the two major types of fractures, radial and concentric first (see fig. 1)
- Examine the fractured face for the arcing conchoidal pattern and their orientation to the surface of the glass pane (see fig. 2)
 - The first fracture that occurs in a mechanical breakage is the radial fracture. It is this fracture that starts at the point of impact and radiates away from the impact point.
 - The fractured surface of this radial is what is examined for direction of force determination. The concentric fractures are typically the opposite in direction of force features although they can be misleading as the concentric fracture could occur while the pane is rebounding in the opposite direction.

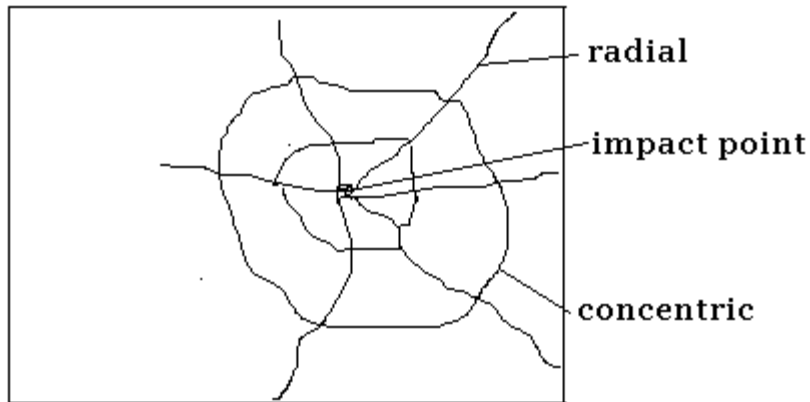


fig. 1 impact fracture

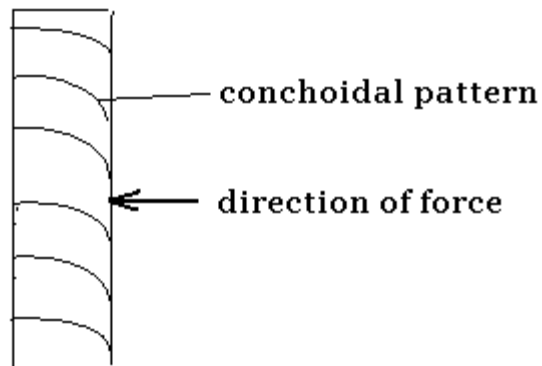


fig. 2

**broken edge of a
radial fracture**

- When multiple impacts occur to a pane, it may be possible to determine the sequence of impacts
- A fracture, radial or concentric, will not cross a previously existing fracture. If the radial of a second impact meets a previously existing fracture it will terminate at that point (see fig. 3)

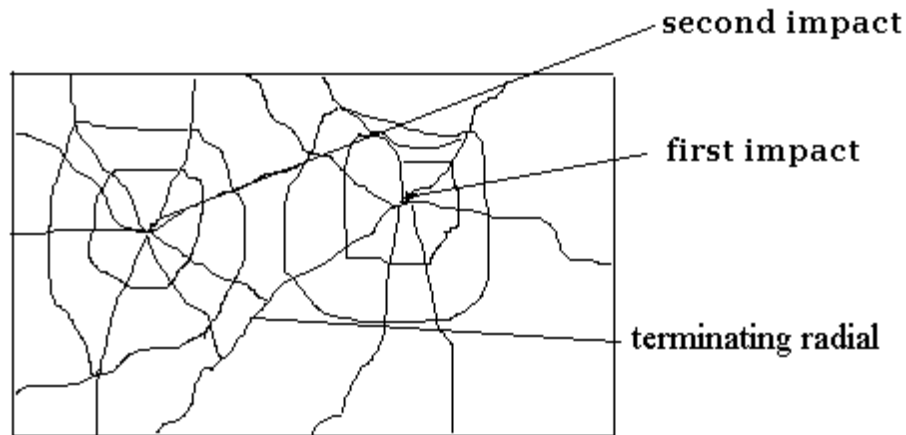


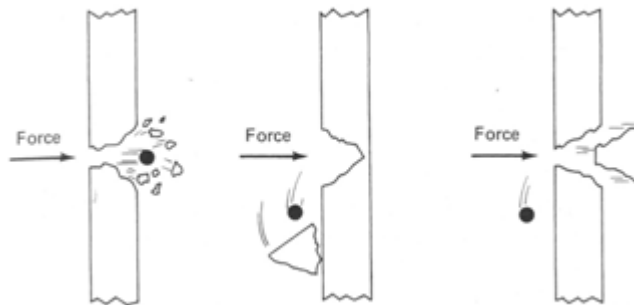
fig. 3
sequence of fractures

- Impact fractures in tempered glass are often not possible to evaluate due to the numerous small glass cubic fragments produced.
- The point of impact may be determined by the general alignment of the fracture lines that tend to radiate from the impact point.
- If a second impact occurs in the same pane and does not cause complete failure of the pane, that second impact is marked by a significant loss of glass at the impact point.

13.3.3 DIRECTION OF FORCE DETERMINATIONS

Glass fractures when the limits of its elasticity are reached. The fractures propagate in a predictable manner and result in features that are reproducible under similar conditions. Examination of these features will allow the analyst to determine which side of the glass the force originated from.

Glass that is struck by a high-velocity projectile will produce a coning or cratering effect on the side of the glass opposite the force (the exit side).



The diagram depicts three events when glass is struck by a projectile:

- A perforating projectile that causes cratering on the exit side of the glass
- A projectile that does not perforate (one of a lower velocity) may cause broken glass to fracture on the side towards the force. Such low velocity projectiles, such as a thrown stone, may leave a crater on either side of the glass so these instances must be interpreted with caution
- A third possibility involves a projectile that causes the appearance of complete perforation of the glass and cratering on the exit side; however, the projectile itself does not penetrate and falls on the side where the force originated.



Photograph of cratering on the exit side of the windshield.

- Laminated glass, because it is two sheets of glass sandwiching a laminate material, may bulge and remain bulged in the direction of force. This may assist the analyst to determine direction of force.
- The laminate material may also protrude in the direction of the force.

13.3.4 IMPACT LOCATION DETERMINATION

When a large hole is created in glass by a projectile, it may be possible to determine the impact location using the radial fractures. Strings may be aligned along radial fractures across the hole, attempting to locate corresponding fractures at ~180 degrees. The intersection of these strings will indicate the approximate impact location.

13.3.5 INTERPRETATION

In tightly held glass window panes with the impact point close to the window frame and in small windows, the interpretation of direction of force is not possible due to artifacts induced by the frame holding the glass.

It is best to examine broken glass that is still held in the window frame. This will allow determination of the “inside” and “outside” of the window and eliminate the potential of secondary breaks produced on the ground. This will also allow for a ready determination of a radial fracture.

- Locate a radial fracture and its origin
- Examine the broken edge of the radial to determine direction of force
- Avoid examining a concentric fracture as the potential exists that such a fracture was made after the initial breaking impact
- Since fractures will not traverse an existing fracture, the sequence of multiple impacts can be determined by examining the location of terminating radials and from which impact the radial was produced

13.4 FRACTURE MATCHES

Fracture matches involve reconstructing fractured material that was once part of a single unit back into a single unit by fitting the fractured items back together. A positive fracture match is conclusive evidence that fractured materials were once a portion of a single unit. Physical and chemical analysis of materials may support a fracture match, or may be conducted in cases where a fracture match cannot be made. Fracture matches can be made of numerous materials including glass, plastics, vehicle parts, paint, tapes, fabric and paper.

When collecting items for a fracture match, protect the broken items from further damage by cushioning fragile items and packaging them in crush-proof containers. Cardboard "sandwiches" may be used with larger pieces of cardboard to protect the item from further breakage.

Avoid attempting to conduct a fracture match at the crime scene.

13.5 HAIRS AND FIBERS

Hairs and fibers may be transferred when two objects come into contact with each other or into proximity with each other. Submission of questioned hairs and fibers as well as known hair and fiber samples to the laboratory allows for comparison of physical, chemical, and optical properties and a determination if there is a significant association.

The crime scene analyst will look for items that may be used for either fracture matches, comparison of questioned fibers to known fiber samples, or human hairs that might be suitable for DNA testing. Hairs can also be collected for investigative information including human versus animal and somatic origin.

Particular areas of the crime scene that the investigator might consider as potential areas of deposit and or sources of hairs and fibers that might be significant to the investigation, include, but are not limited to the following:

- Victim and/or suspect clothing, personal effects, and person
- Carpeting and floors
- Furniture
- Vehicle upholstery, floor mats, and seats
- Points of entry and exit from the crime scene

13.5.1 GENERAL PROCEDURES FOR HAIR AND FIBERS

- Hairs and fibers may or may not be visible to the naked eye
- Generally hairs and fibers are collected with clean forceps or gloved fingers
- Products with low-tack adhesives (such as clean post-it notes or footwear impression lifts) may be used for hair and fiber collection
- Collect clothing items and linens when they may contain significant trace evidence of hairs or fibers and package separately for submission

13.6 **GENERAL PROCEDURES FOR LIGATURES AND TAPE EVIDENCE**

The analyst may have to cut the rope, twine or cordage when collecting it from the scene. If so, the newly cut ends should be labeled so the item can be reassembled as it was found. Leave existing knots undisturbed, and package appropriately.

13.7 **PAINT EVIDENCE**

Painted surfaces encountered at a crime scene might range from vehicle paint to building paint, tools, and painted artifacts. Painted surfaces may be repainted over time and paint evidence may reveal characteristic history of layers of paints.

In certain cases, where the paint is suitable, paint trace evidence can be searched against the Paint Data Query database and vehicular information provided as to the possible make, model, and year range of the vehicle from which the questioned paint was transferred.

13.7.1 GENERAL PROCEDURES FOR PAINT EVIDENCE

- Paint evidence may be visible or invisible to the naked eye. A magnifying glass may be needed to detect small paint transfers, such as paint on a tool or weapon
- Use a clean scalpel, razor blade, or cutting instrument to collect paint samples from surfaces. Do not use tape when collecting paint. Avoid scraping which may contaminate or lose evidence
- Collect all layers of paint down to the substrate.
- Paint smears are typically fragile and, when practical, the object containing the smear should be collected as evidence
- When collecting an item with paint transfer, protect the area with suspected transfer by wrapping the area in paper prior to packaging, if appropriate
- Adjacent automotive panels or adjacent areas of a building (i.e. doors and door jambs) may commonly be painted differently. It is important to collect paint samples from as close to the area of interest or damage as possible and be alert for variations in paint, even on the same surface
- Always collect a control sample near the area of interest or damage ensuring the original area isn't affected and the control area is marked appropriately to distinguish it from the damaged area

13.8 **PRIMER RESIDUE**

Primer residue is formed by the ignition of a chemical in primer when a firearm is discharged resulting in the formation of microscopic particles blown out of various openings in the weapon. These particles are highly specific to a particular primer residue. They typically contain the elements lead, barium, and antimony.

The crime scene analyst may use a Primer Residue Kit for collecting trace evidence of primer residue. The kits are used in accordance with manufacturer's instructions and are designed to be used in conjunction with a Scanning Electron Microscope (SEM).

Primer residue may be deposited on the hands or other areas (interior of a vehicle) by circumstances such as firing a weapon, being in close proximity to the discharge of a weapon, handling a weapon that has been fired, or coming into contact with an object onto which primer residue has been transferred. A positive result from a Primer Residue Kit test may indicate one of these circumstances. This test alone cannot determine the relative likelihood of one or the other of these circumstances. A negative result could be consistent with an individual not having fired a weapon or it could be consistent with circumstances such as washing or wiping the hands to remove residue, wearing gloves, or environmental degradation or loss of residue trace evidence.

Primer residue is fragile trace evidence. It is continually lost from the hands due to normal activity. The optimal window of opportunity for sampling the hands of a living individual lasts for up to four to six hours after the shooting event. While primer residue particles may stay on clothing even after washing, there is no way to determine how long primer residue particles have been on clothing and fibers collected on the sampling device may cause problems during analysis.

Because of the fragility of primer residue trace evidence, samples should always be collected at the crime scene whenever possible.

13.8.1 GENERAL PROCEDURES FOR PRIMER RESIDUE

- It is not possible to estimate from a Primer Residue test when primer residue was transferred to an object
- Microscopic primer residue particles tend to follow the path of a bullet and may be found on the hands or person of the victim
- It is important to determine the scientific value of the analysis before Primer Residue Kits are used. For example, if other evidence establishes that an individual possessed a weapon, primer residue analysis may not add additional useful information
- A fired weapon will not always result in primer residue on the hands of the person discharging the weapon
- Primer residue may be obscured by washing hands, wiping hands, wearing gloves, or sweating profusely
- Primer residue may be obscured by environmental factors such as wind and rain, bloody hands, excessive debris on the sample, or more than four to six hours passing between firing and sampling

13.9 **CLOTHING WITH GUNPOWDER RESIDUE**

- Completely air-dry the clothing if possible and appropriate
- Place clothing item flat onto clean paper sufficient to cover the item
- Use paper to separate areas of clothing to ensure that the area of clothing with the gunshot residue does not come into contact with other areas of the garment
- Plastic will cause biological material on the clothing to deteriorate and should not be used

13.10 VEHICLE LAMPS

Properly collecting and submitting lamps from vehicles involved in an accident or hit and run requires specific procedures.

It is important to collect all vehicle lamps that may have bearing on a case. This includes the lamps in the area of the vehicle that was damaged by impact. Consider the necessity of submitting headlamps, parking lamps, front side marker lamps, tail lamps, rear side marker lamps and the backup and license plate lamps as appropriate to the circumstances.

Remove the entire headlamp or taillight assembly, if possible. Package smaller lamps and exposed filaments by nesting the base in a protective enclosure to cover fragile filaments or portions of broken lamp filaments.

Undamaged lamps may help the laboratory analyst in the comparison process. Notes should include the area of a vehicle from which lamp(s) were removed, whether the lamps are from driver's or passenger's side of the vehicle, the position in the assembly housing by denoting what side was up or down, as well as the make, model, and year of the vehicle.

Note whether the switch that controls a particular lamp was in the on or off position.

Alert the requesting agency to hand-deliver vehicle lamps to the laboratory for further analysis.

13.11 EXPLOSIVES AND EXPLOSIVE MATERIALS

Crime scene analyst(s) may encounter a diversity of devices and containers of chemical or materials associated with the manufacture of explosive material. If, at any time, a crime scene analyst feels that they have encountered explosive material within a crime scene they are to contact the appropriate agency such as the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATFE) or local law enforcement explosive unit to collect and render safe any suspected explosive device or material prior to proceeding with the processing of the crime scene.

13.12 GENERAL CHEMICAL MATERIALS

Crime scene analysts may encounter a wide variety of chemical materials of known or unknown substances. Focus will be on collecting trace evidence useful for identification of specific chemicals or chemical types and for comparison of questioned materials to known sources.

General chemical materials may be toxic, poisonous, or caustic and may be dangerous in a liquid, gas, or solid form. Assume that any unknown chemical material is hazardous and make personal safety the highest priority. Refer to MSDS sheets for safety precautions with known chemicals and Section 2.0 Safety, of this manual.

Any hazardous or unknown chemical that has the potential for becoming hazardous and needs to be collected at a crime scene should be done by someone that specializes in hazardous materials such as a Hazmat Team.

13.12.1 GENERAL PROCEDURES FOR CHEMICAL MATERIALS

- Treat any unknown chemical as hazardous and handle with extreme care using appropriate PPE. Identify potentially hazardous materials on the outer packaging
- Provide as much information as possible about the questioned sample including location the substance was found, the condition of the substance as found, properties of the substance (i.e. odor, color, irritant, greasy/oily texture, etc.)
- Document the nature of any injuries resulting from exposure of the victim to the chemical(s) and any known information about pathways of exposure
- Document the method of application of the chemical (i.e. brushed, poured, or sprayed)
- Use extreme caution when handling acids or bases and ensure they are packaged using the proper plastic container (i.e. polyethylene, polypropylene, HazMat collection containers), and no metal containers
- Submit general chemicals including household products in their original container if the container is not leaking
- If sampling is necessary, pour into a secured plastic bottle that contains no metal; be careful not to disrupt the cap or lid of the original packaging to preserve potential DNA evidence
- Place inhalants into airtight containers as soon as possible
- Avoid metal containers for liquids and be aware that some plastic containers may be dissolved by certain chemicals. Avoid collection of trace chemical evidence with swabs
- Package potential volatiles in leak-proof air-tight, metal-lined containers in minimal amounts

Table 2: Collection Methods and Special Considerations in Handling Trace Evidence

ITEM	METHOD	SPECIAL CONSIDERATIONS
Trace Evidence in Hair	Photograph with a scale and particle pick with tweezers, fingers, tape etc.	Combing or brushing of hair for evidence collection should be conducted by the Medical Examiner.
Trace Evidence Recovered by Vacuum Sweeping	Use appropriate vacuum cleaner equipped with a filter trap used to recover trace evidence from an item or area. Vacuum parts, filter, and trap must be changed and rigorously cleaned in accordance with manufacturer's instructions to avoid contamination or cross-contamination.	Use this method subsequent to other collection techniques as it is indiscriminate and may result in the collection of a large amount of extraneous material or lead to cross-contamination.
Trace Evidence Recovered by Gel Lifters	Peel the clear plastic film back to expose the tacky surface. Place tacky side down over the area where trace evidence is being collected. Do not replace clear plastic film over the tacky surface	The thick low-adhesive gelatin layer permits the lifting of trace material from almost any surface including porous materials such as cardboard or paper
Paint or Other Trace Evidence on Clothing of Victim of Hit-and-Run	Air dry bloody or wet items prior to submission. Wrap items in clean butcher paper, and then place in bag for submission	Clothing may be an excellent source of trace evidence and care must be taken to not lose microscopic trace evidence that may not be immediately visible
Spray Paint or Other Paint used for Vandalism	Collect the entire can of paint. Protect the can of paint from drying out by replacing the lid or transfer a small amount of the liquid paint to a glass jar or vial	
Paint Balls	If already dry, submit the item containing the Paint Ball "paint" by wrapping first in paper and then placing in a paper bag. If still wet, swab the wet area with cotton swabs and place in plastic bag. Place intact or expended paint balls in plastic bags	Paint balls are not technically paint, but are made out of food-grade, water soluble materials. They may still be collected for comparison and matching
Primer Residue from Clothing	Collect items of non-fibrous clothing with suspected primer residue in the same manner as clothing with other trace evidence	Unless the clothing surface is vinyl or leather, collection of clothing with primer residue is problematic
Primer Residue from Vehicles	Use a Primer Residue Kit to collect from vinyl, leather, or plastic surfaces. Test in areas where small amounts of settled dust can be seen	Avoid sampling fabric surfaces
Adhesive Tape on Roll or Loose or Wadded	If fracture match of a roll of tape submitted into evidence is desired, protect the end of the tape, and package in a plastic bag or container, unless there is a concern about latent prints. If tape is loose or wadded, do not mark, wrap or distort the tape evidence. Mark tape if it is	If collecting latent print evidence from tape, secure in a cardboard box to eliminate friction within the container

	cut by investigators to remove it from victim	
Unknown Powders/ Liquids/ Solids	If the powder is dry, collect in a paper evidence fold for submission. If the powder is damp or moist and no volatiles are suspected, allow the powder to dry and then package as indicated. Package suspected volatiles in a lined metal paint can. Package liquids in a plastic or glass container	Treat any unknown material as hazardous and handle with extreme caution. If a known source is present, also submit a sample of the known source for comparison purposes
Bank Dye Packs or Articles Suspected of Containing Bank Dye	Place expended or non-expended bank dye packs in a plastic bag and package in a separate container such as a paper bag	Wrap clothing or items suspected of containing transfer bank dye in paper, separating clothing layers, then place in a paper bag
Speedometer Examinations	Package the speedometer or tachometer in a manner to protect the face. Box in a rigid container	
Vehicle Lamps	.	Needs to be hand delivered. Even lamps that have not been broken can show signs of impact

14.0 RECOVERY AND PROCESSING OF HUMAN REMAINS

The crime scene analyst may be involved in locating, collecting, preserving and documenting evidence from bodies and human remains at a crime scene. Procedures for processing evidence from bodies and human remains will vary widely, depending on the nature of the crime scene and the evidence. The investigator may be required to coordinate efforts with medical personnel, the Medical Examiner/Coroner, a Forensic Anthropologist, the District Attorney and/or other agencies before or during body processing.

14.1 SEARCHING FOR HUMAN REMAINS

Cadaver dogs, search teams, and/or individuals trained in the use of underground/underwater detection equipment may be involved in searching for human remains depending on the circumstances. If cadaver dogs are to be used, it is preferable to use this method before the scent of too many human searchers obscures their effectiveness.

For scattered or buried remains, a specialist in buried body processing may assist in collecting evidence or a Forensic Anthropologist may be considered as a resource. Most law enforcement agencies do not have the resources for a large search and recovery effort, so coordination of resources among agencies is often necessary and appropriate. When remains from multiple bodies are involved, a numbering and unique identification system is required to identify a body part as originating from a particular victim if possible.

Visual cues may lead investigators to the site of a clandestine grave. Initially scan the landscape to discern common or baseline features of the topography and aid in the identification of irregularities. Irregularities in both the ground surface structure and the vegetation may provide clues.

In searching for clandestine graves, look for:

- Surface irregularities such as broken ground, fresh surface soil, or disruption of strata
- Inconsistencies with the environment such as tire tracks, garbage, animal burrows, clumps of hair or fiber, cigarette butts, etc.
- Broken vegetation or unnatural vegetation changes. This might include disruption of root balls, unusual plant locations, or staged appearance to natural vegetation. Withered vegetation may indicate recently transplanted vegetation
- Sunken soil, changes in soil density, and/or primary or secondary burial depressions

14.2 PROCESSING OF HUMAN REMAINS AT THE CRIME SCENE

The following guidelines will vary depending on the nature of the crime scene. In general, these principles apply for dead body processing at the crime scene:

- Take all appropriate cautions for biohazards and utilize all appropriate PPE
- Take overall, medium range and close up photographs before and during the processing of remains at the crime scene
- Photographs and notes will document the position and location of the body/remains at the scene. GPS, total station, or HDS may be useful for documenting location.
- Measurements from one or more reference points at the scene to the body's hands, feet, and head are required (assuming the body is intact). This can be useful for sketching the position of the victim in a diagram (not required at autopsy or if the body/remains are otherwise out of context of the scene)

- Do not move the body until it has been considered whether moving the body would destroy or contaminate evidence and only move the body in conjunction with the Medical Examiner or Coroner
- Evaluate the body/remains with the Coroner/Medical Examiner and should any evidence on the body be in jeopardy of being lost during transfer to the Coroner/ME's office, consult the Coroner/ME about recovering that evidence beforehand or otherwise preserving it
- Bindings and ligatures are not to be disturbed, unless they attach the body to the scene. Minimize the number of cuts necessary to release the body from the scene, and document these cuts. Label ends of ligatures or bindings that were cut by investigators

14.2.1 SKELETAL RECOVERY

Locating, recognizing, and recovering skeletal remains provides important forensic evidence in determining the identity of the individual. The crime scene analyst locating and recovering skeletal remains will use diligence to retrieve as many of the human bones as possible. This increases the probability of positive identification based on the anomalous features unique to the individual.

Consider consulting with a Forensic Anthropologist in the investigation of possible sites of skeletal recovery. Be aware of jurisdictional issues, and issues that may pertain to recovery of Native American skeletal remains or disturbance of burial sites of historical, cultural, or religious significance (see section 14.2.3 of this manual).

14.2.2 BURIAL CLASSIFICATION

Surface scatter

Remains are left to decompose above ground. These types of scenes may be large in scope and may encompass a large amount of corresponding physical evidence. In addition, carnivorous scavengers may have relocated a large number of skeletal elements over a large area. General procedures to conduct a surface scatter site recovery are as follows:

- If scavengers appear to have disturbed the remains, be cognizant of where animals take food to feed (underneath trees, in burrows, where they can see danger approaching, along game trails, etc.)
- Locate a fixed point in the landscape to perform the appropriate measurement technique(s) when appropriate. GPS measurements, total station, and HDS may be helpful in this documentation
- Locate with flags or other identifying markers any unusual item found in the field, including clothing, bones, garbage, debris, etc.
- Determine which items previously flagged are of evidentiary value
- Place number or letter placards next to each item of forensic value, photograph, and diagram when applicable
- Note the quantity of skeletal remains
 - Identify what skeletal elements have been found when possible
 - Identify what skeletal elements are still missing when possible
 - Perform an additional search of the area, or expand the search area to recover as many elements as possible
- Collect additional items of evidence and package accordingly

- Collect and release all human remains to the Coroners/Medical Examiner's Office or to the investigating agency with permission from the Coroners/Medical Examiner's Office
- Collect and release all other items of evidence to the investigating agency

Interred Remains

General procedures to conduct a burial site excavation are as follows:

- Remove excess leaf litter and vegetation from the grave surface
- Examine the leaf litter and vegetation for trace evidence (hair, clothing, jewelry) in a location away from the burial site
- Stake out a work area around the burial area for diagramming and measuring purposes
- Locate a fixed point in the landscape to perform the appropriate measurement technique(s)
- Work horizontally:
 - Sift the soil layer by layer
 - Orient the shovel blade so that the ground is scraped away horizontally
 - Document all changes in soil density, color or texture
 - Stop and document as each item of evidence is discovered
 - Stop when the skeletal remains are first discovered
 - Remove enough dirt to determine the orientation of the body
 - Remove as much soil around the skeletal elements without disturbing their position and document
 - Disinter the remains and all associated evidence
 - Continue excavating after remains are recovered to look for evidence under the burial level
- Collect soil samples from each strata during excavation
- Collect and release all human remains to the Coroners/Medical Examiner's Office or to the investigating agency with permission from the Coroners/Medical examiner's Office
- Collect and release all other items of evidence to the investigating agency

14.2.3 NATIVE AMERICAN SKELETAL REMAINS DIVISION POLICY

Special consideration is required if, during the processing of skeletal remains, it is suspected or becomes evident that the analyst is unearthing Native American remains. The following protocol will be followed:

1. Notify the lead investigator of your suspicions that the skeletal remains may be Native American. Advise that the recovery process should stop and notifications per [RCW 68.50.645](#) (3) shall be made
2. Document in the case notes
3. Notify the CSRT Manager.

15.0 ENTOMOLOGY EVIDENCE

With the proper collection of entomological evidence, a forensic entomologist may be able calculate the time of infestation (which could in turn lead to a time of death estimate), whether or not a body has been moved, and other forensically significant information. In addition to the insect evidence, the entomologist also requires thorough documentation of the scene itself including temperature documentation. The time required for insects to undergo their life cycle development is determined largely by the temperature and relative humidity associated with those species present in a particular environment. The entomologist can only work with the information provided. It is crucial that the investigating personnel learn and follow the steps outlined here and as recommended by the entomologist.

15.1 SPECIFIC EQUIPMENT

- Aerial and/or sweep insect net
- Kill jar (a jar with an absorbent material in the bottom such as Plaster of Paris or cotton)
- Collecting vials
- Plastic forceps (tweezers)
- Plastic containers
- Paper to use as labels for the collection containers
- Pencil (ink will run on labels submerged in liquids)
- Scissors for cutting paper labels to size
- Apple corer or trowel for soil sampling
- Plastic zip-style bags
- Thermometers, electronic and/or mercury
- 95% Ethyl alcohol
- Ethyl Acetate (nail polish remover)
- Styrofoam coolers
- Shipping containers
- Wet liver cat food or beef liver

15.2 PREPARATION

As important as the collection of specimens at the scene, documentation is a critical element of the interpretation process. An analyst should be prepared to spend a considerable amount of time noting observations and photographing the scene and insects present. Before proceeding with collection, all materials needed should be prepared and ready.

15.3 DOCUMENTATION

The notes taken at a scene with insect evidence should be provided to the entomologist who will be analyzing the insect evidence to give them as much information as possible since they are not able to be present at the scene.

Before beginning collection, the analyst should record in their notes the following (this list is a minimum, additional data may be deemed necessary and are scene dependent):

- Date victim found, date reported missing, last seen alive, location found when available
- Site description
 - Rural, urban, aquatic, etc
 - Description of the types of plants, buildings or whatever else is in the microenvironment
 - Current weather conditions and temperature; sunny, overcast, rainy, etc
- Status of the body
 - Position of body
 - Clothed or nude
 - On the surface of the ground or buried
 - In an enclosure or out in the open. If in an enclosure, describe the enclosure
 - Apparent injuries to the body
 - State of decomposition; fresh, bloat, decay, skeletal, etc
 - In the sun or shade at the time of examination. Would these conditions be different at different times of the day
- General observations about insects
 - Approximate number of flying and crawling insects that are immediately visible
 - General locations of major insect activity (note: forensically significant insects typically lay their eggs in natural body openings and open wounds)
 - Is there insect activity within 10 – 20 feet of the body; describe flying, resting or crawling insects present
- Note any unusual naturally occurring, manmade, or scavenger-caused phenomenon, which could alter the environmental effects on the body, example: mutilation of the body, burning, covering or enclosing of the body, burial, movement, or dismemberment

15.4 COLLECTION OF SPECIMENS BEFORE BODY REMOVAL

To prepare for collection of insects, have a sweep net ready, “charge” the kill jar by pouring ethyl acetate into the absorbent material; pour 95% ethyl alcohol into glass vials or jars. Labels that accompany the live and preserved specimens should look like the following and be cut to the size of the container.

Date
Case #
Sample number
Brief description of sample and location on or around the body (ex. Maggots from right eye socket)
Collector

- Approach body slowly to avoid disturbing the flies
- Carefully lower sweep net over area with greatest concentration of flies. As flies move to the closed end of the net, sweep quickly and flip net to create a fold preventing escape of flies
- Carefully transfer insects from the net into the kill jar and secure the lid (insects by nature move up so by putting the jar upside down over the trapped end of the net and then inverting the net into the jar will decrease the likelihood of insects escaping)
 - Wait several minutes until flies have stopped moving before transferring dead insects into a vial with 95% ethyl alcohol
 - Add a label, in pencil, to the sample
- Wait several minutes for flying insects to return and continue sweeping and collecting in the same manner until a representative sample of all flying insects present has been collected
- Take the temperature at 4 feet above the body, 4 inches above the body, at the body surface (touching the body), between the torso and ground or other point of contact, and between the head and ground
- Take the temperature at individual maggot masses (100s – 1000s of maggots). If maggot masses have converged, take temperature of masses about the head, torso and genitals
- Collect ~30 maggots, if possible and place into vial of 95% ETOH. If there are several sizes of maggots, all sizes should be included in the sample, collecting ~30 of each size, if possible. Include a complete label with the vial. Repeat with all maggot masses, collecting representatives from each mass into separate vials
- Collect a “companion sample” of maggots from each of the masses preserved maggots were collected from. Do this by collecting representative maggots into a plastic food container along with soil (or substrate) surrounding the remains. Add some liver cat food or beef liver. Include a label with the live specimens and in addition to the standard information that goes on this label, include the sample number of the preserved maggots this corresponds to
- If the maggot masses have converged, collect live and preserved maggots from the head, torso and genitals

- Collect, by hand, any non-flying insects noticed on the surface of the body and indicate the area of the body they were collected from. Put these insects in 95% ETOH. It is okay to mix different kinds of insects in the same vial if from the same part of the body if they are in ETOH. Note: some insects present on a body may actually be predators of those feeding on the body so avoid mixing different types of live insects in the same container

15.5 COLLECTION OF SPECIMENS AFTER BODY REMOVAL

Soil listed below are for entomological purposes only. If soil analysis is required additional specimens shall be collected separately. In instances where bodies are outdoors and heavily infested, many insect adults, larvae and pupae as well as other arthropods will remain on the ground after the body is removed.

- Soil temperatures should be taken immediately following body removal at a ground point, which was under the corpse prior to removal. Also, take soil temperatures at a second point 3 – 6 feet from the body.
- A number of specimens should be collected and preserved, while a second sample should be collected alive for rearing
- Collect litter samples (leaves, grass, bark, etc) or any material on the ground surface close to or under the corpse
- Look for maggots moving away from the body approximately 3 feet from the body in all directions. These maggots can be preserved in 95% ETOH; include the distance away from the body, compass direction and what portion of the body they were moving away from on the label
- Look for and collect puparia. Put puparia (open or closed) in 95% ETOH. Continue looking for puparia out 3 feet from the body. If none are found, make a note of the distance you looked . If the body is outdoors and on an artificial surface like cement, begin an additional 3 foot search at the nearest protected spot (grass, under rocks or debris).
- Collect the first inch depth of soil under head, torso and pelvis. Save in a zip bag with label including the location and depth.
- Collect second inch depth of soil under head, torso and pelvis. Save in a zip bag with label including the location and depth.
- With older (advanced decomp, dried or skeletal) remains when the entire skeleton is present, collect soil samples (approx. ½ quart each) and indicate the compass direction and distance from skeleton. Collection will be ~18 soil samples
 - Samples 1 – 6 will be at body contact from head clockwise
 - Samples 7 – 12 are three feet from the edge of the body beginning at the head-end and moving clockwise
 - Samples 13 – 18 are at six feet from the edge of body beginning with the head-end and moving clockwise.
 - If only a portion of the body or skeleton is present, note this and modify collection of soil samples to include collection at the same distances as above but not necessarily the same number of samples if there aren't a large number of remains present (i.e. only the skull)
- If an obstruction exists in the area where a sample should be taken from, note this and continue collecting remaining soil samples.

IMPORTANT: If the victim is transported to the morgue prior to an analyst collecting the larvae, follow the above procedures as closely as possible at the scene and at the morgue. Soil sample collection in the location of where the body had been removed from will be critical at this step. Follow the procedure for collecting soil samples above.

The analyst should attempt to find out the temperature of the cooler the body was kept in along with how long the victim has been in the cooler. Also, the temperature of the maggot mass should be recorded when the body is removed from the cooler. Although missing the collection at the scene will diminish the value of the entomological evidence, later examination of the larvae could still yield valuable information.

15.6 SHIPMENT OF LIVE SPECIMENS

It is important that the entomologist have entomological evidence shipped to them immediately so the larvae can be reared. Once it is known that the analyst will be investigating a scene with insect evidence, a call should be put in to the entomologist to pre-arrange shipment methods.

All live and preserved specimens should be packed in a Styrofoam cooler and hand delivered, or placed in a shipping box and shipped via next day service (or same day, if possible) to the entomologist. This will be coordinated through the requesting agency and the insect evidence will be turned over to them prior to shipping.

16.0 VEHICLE PROCESSING

The types of evidence that should be searched for in a vehicle will be dependent on the type of crime being investigated. It is important for the Crime Scene Analyst to establish a specific and organized approach to processing a vehicle.

16.1 DOCUMENTATION

- Document the vehicle as it is upon arrival. Note make, model, color, license plate number, state of issue, Vehicle Identification Number (VIN), and any other information that may be appropriate
- In some cases, the specific location of the vehicle may be of important evidentiary value. In these cases, specific measurements to place the vehicle at the scene should be collected
- Exterior/interior damage (if related)
- Any transient details regarding the condition of the vehicle should be noted when appropriate, for example:
 - Windows down/up
 - Exterior wet/dry/condensation
 - Odors present in the vehicle
 - Position of the gear shift
 - Tire conditions (including manufacturer, size, and DOT number)
 - Steering column intact/damaged
 - Ignition switch intact/damaged
 - Lights on/off
 - Mileage and trip meter reading

16.2 EVIDENCE OBSERVATION AND COLLECTION

After consultation with the agency as to what type of processing is necessary, evaluate the vehicle from the exterior in being mindful of processing-order (friction ridge impressions, DNA, trace, etc.) and environmental conditions.

- Divide the evaluation of a vehicle into sections to ensure all relevant areas of the vehicle are searched. This could include underneath the exterior of the vehicle, under the hood, inside the trunk, underneath the seats, along the sides of the seats, inside all compartments (glove box, interior door side map compartments, center console, ashtrays), and behind visors
- Exercise caution when searching underneath seats or in difficult to see areas. Avoid blindly reaching into areas to avoid being punctured by a contaminated needle or injured by a hidden weapon. A small mirror and a flashlight will allow the analyst to search these areas more carefully
- Follow the procedures described in this manual for the evaluation and collection of evidence in and around a vehicle

16.3 SQUARING OF VEHICLE

Shots into vehicles

Shots into vehicles can be problematic due to the many curved and irregular surfaces. The design features of vehicles can also make it difficult to locate useful reference points and measure from them.

Establishing an Internal Baseline for Vehicles

Vehicles often have a logo, inside rear view mirror, or a rear inside brake light that are engineered to be at the centerline of a vehicle. These engineered landmarks can be used as reference baselines to record the position(s) of bullet damage.

A string anchored between these engineered landmarks at the vehicle's front windshield and back window will allow the vehicle to be divided into a left and right side. This will allow measurements to be taken relative to this base line. An example would be a bullet impact was located five feet from the back windshield, two feet to the right of the center baseline and three feet up from the level of the floor.

Establishing an External Baseline (squaring) for Vehicles

To provide external reference lines around a vehicle, one must first find two relatively parallel positions along one of the sides of the vehicle. A fixed measure, for instance 3 inches out from the center of the hub of the front and back wheels, can be marked on the ground. Connecting these two points constitutes a straight baseline that represents the side of the car. Once these two points have been defined, a tape measure or string can be used to construct a straight line with these two points and allow for easy measurements from the front or back of the vehicle.

Next, hang a plumb from the center of the front or back of the vehicle and mark that position. Connect the plumb position to the side baselines by extending a line all the way across the front and/or back of the vehicle. Use of a carpenter's square or something similar may be helpful to ensure the lines intersect at 90 degrees. Two sides of a rectangle should be defined on the ground – one across the front and/or back and one along one of the sides. If needed, the other two sides of the vehicle can be referenced in the same manner described completing a reference line around the vehicle.

Once the baselines have been established, measurements of bullet defects on the exterior of the vehicle can be identified by measuring "x" inches back and "y" inches over, relative to the external baselines. The height relative to the floor/ground will also need to be recorded.

17.0 QUESTIONED DOCUMENTS

A questioned document is any material substance bearing visible or invisible marks or symbols, handwritten or printed, whose authenticity or origin is under scrutiny, and may appear on paper, walls, items of clothing, or on the human body.

17.1 TYPES OF QUESTIONED DOCUMENTS

Examples of questioned documents that may be collected by the crime scene analyst include, but are not limited to:

- Robbery/demand notes
- Threatening letters
- Suicide Notes
- Checks
- Credit Card receipts
- Counterfeit documents
- Currency
- Torn and cut paper
- Altered and/or obliterated documents
- Photocopies
- Forged signatures
- Forged documents
- Blank notepads or documents

17.2 GENERAL HANDLING AND PACKAGING OF QUESTIONED DOCUMENTS

Some general principles and methods for forensic examination and analysis of questioned documents are:

- Questioned documents are often fragile evidence and need to be handled accordingly
- Questioned and known documents should be packaged separately
- Label evidence packaging prior to putting questioned documents in the package
- Indicate "Do not fold/bend" on the packaging
- Evidence containers should be large enough to hold document evidence without folding
- Never staple, fold, or bend questioned documents

Table 3: Collection Methods and Special Considerations in Handling Questioned Documents Evidence

ITEM	METHOD	SPECIAL CONSIDERATIONS
Indented Writing	Collect documents or notepads and place in a folder or sandwich between rigid cardboard to protect from additional indentations. Place in a pre-labeled evidence container	Indented writing should be processed before latent prints. Indented writing cannot be recovered from items processed for latent prints
Charred Documents	If the evidence is found in a fireplace or wood stove, close the damper before recovering the charred material. Slide a piece of heavy paper under the charred paper and carefully place on a cushion of tissue paper in a rigid box. Instruct the requesting agency to hand-carry to the laboratory as soon as possible	Be sure to mark the top of the box and indicate THIS SIDE UP. Package to prevent air currents from impacting the documents. Treat as exceptionally fragile and label as such
Water-soaked Documents	Package documents so the moisture content is maintained. Instruct the agency to hand-carry to the laboratory as soon as possible. Do not attempt to separate any of the layers at the crime scene	
Crumpled Documents	Do not try to straighten the documents. Simply package in a rigid container	
Typewriting, Typewriters, Printers, and Scanners	Submit the suspected typewriter, printer, or scanner along with any known standard samples of extra wheels or typing elements	Submit with ribbon(s) still on the machine.
Torn Documents	Do not attempt to piece back together. Carefully place all pieces in an envelope	Excessive handling may destroy important information. Fracture matches may be possible
Matches and Other Torn Paper	Package the match book separately from any partially burned or unburned matches. Send to the laboratory for fracture matches and possible latent print examination	Keep away from heat. Consider any torn item(s) to be fragile evidence
Paper (Stock) Products	Collect known and suspected samples. Package separately and submit for comparison analysis	Dimensions, weight, color texture, watermarks, composition and other characteristics may be significant for comparison
Graffiti	Cut out, remove the surface, or photograph the writing	Take photographs perpendicular to the writing with a scale and without the flash

18.0 SOIL AND GEOLOGICAL MATERIALS

Soil consists of loose aggregates of rock, mineral, and botanical material. Due to its widespread occurrence and tendency to adhere to most materials, soil is commonly present on physical evidence.

18.1 COLLECTION

- Examine clothing or other materials for stains, smears or clumps of soil. Soil may fall from clothing as it dries; therefore collect clothing as soon as possible. Do not remove the soil from clothing; it may contaminate the evidence.
- Lumps of soil with distinctive layers can be found in or on vehicles. Do not vacuum samples; this will result in a mixing of different soil.
- Examine the exterior and undercarriage of vehicles for areas of missing soil. The shape of such gaps can be compared to soil found at the scene for a physical match.
- Tools and weapons may have lodged soil adhering to them. Do not attempt to remove the soil, submit the entire tool or weapon. Tools with soil must be protected to avoid loss or contamination of the questioned soil. The area containing the soil should be covered and protected. Each tool should be packaged securely into an appropriate container (i.e., box)

18.2 PACKAGING

- Each of the collected soil samples must be packaged separately in suitable containers such as lined paint cans and zip-sealed bags.
- Containers must be sealed to ensure that no leakage occurs
- If the soil is moist or wet upon collection, the assisted law enforcement agency should completely air dry the collected samples prior to final packaging. This should be done in a secure location and covered with a breathable material so as to prevent environmental contamination of the sample
- Soil clumps can be gently wrapped in tissue paper and placed into small cardboard boxes of a size that the clump will not freely move within the box

18.3 CONTROL/REFERENCE SAMPLES

- To collect a soil sample, use any suitable tool to scrape about 2 – 4 tablespoons of soil from a surface area of about 6 by 6 inches into a container. Wipe the tool clean between each sample collection or use a new tool for each sample.
- Do not scrape below a depth of ½ inch except when there is an indication that the questioned sample may have come from a deeper layer of soil
- When there is a footwear impression at the scene, collect a sample directly from it after all photographs are taken. If the impression is to be cast, collect soil adjacent to the cast.
- Where there are several footwear impressions over a distance, collect a sample from each different soil (using color as a guide in determining a change from one type of soil to another)
- Additional samples should be collected from any location where the suspect may have been, or claims to have been during the time of the crime

18.0 BOTANICAL MATERIAL

Botanicals evidence typically involves small, often incomplete fragments of leaves, woody and non-woody fibers, needles, grass, stems, thorns, weeds, flowers, tobacco, seeds, diatoms, pollen and spores which are found as associative evidence on or in clothing, vehicles and soil.

18.1 COLLECTION

- If botanicals are suspected to be on clothing or embedded in the soles of shoes, do not attempt to remove them at the scene. Handle the clothing carefully so that the fragments are not lost or transferred to other items. Wrap each article of clothing in clean paper and package them in separate paper bags. Do not vacuum botanicals; many are very brittle
- Large pieces of plant material caught under vehicles should be carefully removed and packaged into suitable containers i.e., cardboard boxes, paper envelopes

18.2 PACKAGING

- Do not place moist botanicals in plastic or glass containers. If the botanical material is moist or wet upon collection, the assisted law enforcement agency should completely air dry the collected samples prior to final packaging

18.3 CONTROL/REFERENCE SAMPLES

- Collect control samples from botanical sources observed along suspected paths leading to and from the crime scene
- Sample whole specimens if possible, including the root, leaves, seeds, etc.
- To collect vegetation along a path, obtain a clean fabric material such as a bath towel or blanket of similar size and drag it through the pathway along the ground. Small thorns, seeds, etc. will adhere to the fabric material. Package the fabric material in a suitable container such as a paper bag.
- Living specimens (i.e., leaves etc.) that are collected need to be either submitted as soon as possible to the crime laboratory, or placed between clean paper, such as newspaper, to dry prior to submission to the laboratory.

19.0 HIGH DEFINITION SURVEYING (HDS) FOR CRIME SCENE DOCUMENTATION

INTRODUCTION

High definition surveying is a versatile and accurate 3-dimensional (3D) laser scanning technique which uses a high-speed laser and a built-in or attached digital camera to rapidly photograph and measure objects at a scene. It can be used indoors and outside, in bright sunlight or total darkness, and adverse weather conditions. The crime scene data that has been captured is preserved for later examination and reconstruction, and can be used to create extremely accurate 2-dimensional as well as 3-dimensional scene diagrams.

Imaging laser scanners utilize a high-speed laser and a built-in digital camera to rapidly photograph and measure objects at a scene. They can be used in moderate weather conditions to capture and preserve measurements that can be integrated with HDS data.

19.1 APPARATUS AND EQUIPMENT

Leica ScanStation C10

Leica ScanStation P20

Leica ScanStation P40

Leica BLK360 Imaging Scanner

NCTech iSTAR™ Fusion 360° Panoramic Camera

Fanotech® Nodal Ninja Spherical Panoramic Tripod Head

Nikon DSLR (D700 or D810) with an attached 16mm AF Fisheye-Nikkor f/2.8D Lens

Current version of Leica Cyclone software

Current version of Leica IMS Map360 software

Current version of ReCap Pro application software

19.2 ADVANTAGES AND LIMITATIONS

The 3D laser scanner is an objective tool where everything in the field of view is assigned a unit of measure. A large quantity of measurements can be made in a relatively short time frame. The overall quality (accuracy and precision) of measurement is far better than that of manual methods of the past. The scanner is a line of sight device meaning that anything not in the direct line of the laser will not be captured. For this reason numerous scans may be required to capture the scene in its entirety.

The scanner is fully operational between bright sunlight and complete darkness; however, accompanying photographs require sufficient lighting. Should scanning in darkness be required the data may be collected without photographs but the final work product(s) will be limited. Adverse weather conditions may increase noise in a scan, or preclude the use of an imaging scanner altogether.

Operational conditions for each model of scanner can be found in the table below. The complete lists of product specifications and field manuals can be found on the Portal.

	3D Position Accuracy (within 100m)	Minimum Operational Temperature	Maximum Operational Temperature	Maximum Scan Range
ScanStation C10	6mm	0°C (32°F)	40°C (104°F)	300m
ScanStation P20	6mm	-20°C (-4°F)	50°C (122°F)	120m
ScanStation P40	6mm	-20°C (-4°F)	50°C (122°F)	270m
BLK360	6mm (within 10m)	5°C (41°F)	40°C (104°F)	60m

19.3 PROCEDURE

Prior to setting up and scanning a scene, preparing a proper scanning plan is suggested. It may be beneficial to draw a sketch to map out the setup stations for the scanner and target locations required to properly document the scene. Name the scan locations (for example: SW#1, SW#2, etc.) and identify target locations (T1, T2, etc.) on the scan plan if target-based registration will be used.

19.3.1 Operation of the Cxx and Pxx Series ScanStations

The following are suggested procedures for operating the ScanStation scanners but are not intended to limit the use of additional methods outlined by the manufacturer.

Set up the scanner:

- Set up the tripod or stand at scan position SW#001.
- Attach the Tribrach to the tripod and make initial leveling adjustments.
- Set the scanner on the Tribrach and secure.
- Using the bubble level on the scanner make any additional leveling adjustments.
- **REMOVE THE TOP HANDLE.**

Set up targets (if applicable):

- Assemble the NIST traceable twin target pole and tripod.
- Place HDS targets according to the scan plan (if applicable).

Power up:

- Install two charged batteries into the scanner head.
- Power on the scanner by pressing the silver power button (hold button until audible beep).

Create a new project file for the case in the main menu under the Manage icon and then store the new project.

Electronic level

- Touch the 'level' icon; make adjustments; return to the main screen by using the "X" escape/back button.

Set Scan parameters under the Scan menu

- Select and set Field of View parameters with the drop down box
- Select and set scan resolution
- Select and set image control parameters

Capture high resolution scans as necessary within each ScanWorld location. If an external camera is used to capture images, remove the scanner head and affix the Fanotec® Nodal Ninja with an attached DSLR camera, or the NCTech™ iSTAR Fusion 360° panoramic camera.

Advance to the next scan world position. Back out to the Scan Begin window and select the Standard Setup button on the C10 to create a new ScanWorld. Back out to the Scan Begin window and select the Continue button on the P20 and P40 to create a new ScanWorld.

A status bar will confirm your new ScanWorld location on the P20 and P40. In order to view the current ScanWorld location on the C10, place the stylus over the blue "Idle State" bar.

Repeat the previous steps until the scene is sufficiently documented. It is suggested to collect Target All scans to aid in the registration process.

The data should be downloaded to a USB drive.

19.4 INTERPRETATION

Once the data has been collected it will need to be placed onto a computer with Cyclone software for analysis. The scanner data must be imported and a database created in Cyclone. Once the database is created TruSpace and/or ModelSpace can be used to measure objects and capture 3D snapshots that can be saved as JPEG files.

Registration is required to stitch multiple scans together. This can be accomplished either with target registration (if targets were used) or cloud based registration (if no targets were used). Once all the scans are registered a ModelSpace can be prepared from the combined scans. A ModelSpace is used to prepare a KeyPlan. Once the KeyPlan is prepared a published TruView file can be created. The published TruView file and any other file created from the raw data are considered the final work product(s). Final work product(s) will be released to the requesting agency and this will be documented in the case file.

Additional software such as IMS Maps360, or AutoDesk software utilizing CloudWorx plugins can also be used to generate work product. The work product generated from these platforms will be treated in the same manner as mentioned above.

19.5 QUALITY ASSURANCE

Verification of a NIST traceable twin target pole (TTP) will be scanned at least once on scene when using ScanStation scanners. The data should be verified on-site using the target measurement tool. If conditions exist (ex. weather) that require an expedited scan and the TTP cannot be measured on-site, the TTP check may be withheld until working within the Cyclone software. Conditions that preclude the on-site check will be documented in case notes. The distance between the two targets must fall within the range of 1.695 meters to 1.705 meters for the 1.700 meter pole and 0.995 to 1.005 meters for the 1.000 meter pole and will be documented in the field notes. If the TTP is out of the acceptable range, the ScanStation will be restarted and the verification will be repeated. If the TTP is out of range again, a call to the Leica HDS Support Hotline (1-800-367-9453) should be made and the ScanStation will be removed from service until it can meet the quality assurance standard required above.

The ScanStation C10, P20, and P40 will be sent to the manufacturer for calibration at least once every three years. After calibration or maintenance, a performance check of the instrument to include scanning the twin target pole will be done prior to the instrument returning to service, and the results will be stored in the scanner's maintenance and verification logbook. The instrument's maintenance and verification logbook will be maintained by the CSRT Manager.

The BLK360 imaging scanner does not capture targets and therefore no TTP measurements are captured on scene.

19.6 DISPOSITION OF WORK PRODUCT

The scanner data, including any externally captured associated panoramic images, requires processing in Cyclone software prior to releasing a finished work product(s) to the requesting agency and therefore cannot be released at the culmination of the scene. The scanner data is saved onto the hard drive of the device and remains on the scanner until deleted by the user. This data from ScanStation scanners should be copied onto a removable media card prior to exiting the scene. Should insufficient memory for further scanning be on the ScanStation's hard drive, the data may be copied onto a removable media card and the hard drive data deleted. Images obtained from an external imaging technique, either a DSLR camera or iSTAR camera, should be copied onto a removable media card prior to exiting the scene. Data from BLK360 imaging scanners will be transferred via Wi-Fi to a computer upon return to the laboratory.

UPON RETURN TO THE LABORATORY:

Copy/transfer the original scanner data, to include externally captured associated panoramic images, in their original format onto a secured external hard drive, computer, or server to be retained as part of the case record.

Prepare a disc or media card with the final work product(s). This disc or media card will be marked with, at minimum, the date it was created, the laboratory case number, the investigating agency case number, the scientist's initials. This will be documented in the case file and noted in LIMS. Any final work product(s) prepared must be reviewed by a secondary responder(s) and a technical reviewer with this information documented in LIMS prior to release. Any copies of the final work product must be administratively reviewed before release to an agency and must be documented in LIMS.

The removable media card (and scanner's hard drive, when applicable) may be cleared of scanner data for reuse.

If the crime scene requires an overnight stay, the scanner head or the media card containing the scanner data (along with the media card containing externally captured panoramic digital images when applicable) should be secured on a CSRT member or within the room as appropriate throughout the duration of the stay.

20.0 OTHER FORENSIC TOOLS

20.1 METAL DETECTOR

In addition to a visual exam, a metal detector may be employed to assist in the search for metallic items of evidence including, but not limited to: weapons, spent bullets, cartridge cases and live cartridges or ammunition components.

Refer to the product manual for operation of the metal detector being used.

Prior to use at a scene, the operator will test the unit by placing a metallic object, i.e., cartridge, cartridge case, coin etc., on the ground and the metal detector must audibly sound a “beep” when passing over the object.

20.2 ALTERNATE LIGHT SOURCE (ALS)

In addition to visual examinations and searches, an alternate light source may be employed to assist in the search for biological evidence and to enhance fluorescent latent fingerprint powders. Fluorescence/absorption may indicate the presence of a biological fluid. However, further analysis (acid phosphatase test, sperm search, urea test, amylase, or Phenolphthalein test) must be performed before the presence of a biological fluid is determined. The absence of a fluorescence/absorption result does not confirm the absence of a biological fluid.

Refer to the product manual for operation of the alternate light source being used.

21.0 REPORTS AND THE RELEASE OF INFORMATION

Procedures for the release of case file information and reports are addressed in the CLD QOM.

21.1 REPORTS

Any results released from the laboratory will be contained in a formal written report, and these reports will be prepared in accordance with existing CLD policy. The following reviews are required in order:

- Secondary review (if applicable) – a secondary crime scene responder shall, at a minimum, review the report prepared by the primary responder. Once completed this review will be documented in LIMS (Laboratory Information Management System) as a secondary review activity.
- Technical review – the casefile and report will be independently reviewed by a qualified primary CSRT member per technical review procedures outlined in the CLD manuals. This technical review will be documented in LIMS, the case file on the technical review check list, and by initials and date on the draft report.
- Administrative review – will also be conducted prior to release of the report and will be documented in LIMS and on the technical review check list.

In addition to the requirements outlined in the CLD QOM the following information will be included in all reports:

Crime Scene Response Overview

- Date of response
- Assistance requested
- FLSB members present
- Address or location of scene (i.e. location of residence/where vehicle was examined)

Disclaimers if applicable

- Limitations of testing
- Measurements are approximate
- Description of appendices and/or glossary
- Description of chemical tests

Observations

Results and conclusions (where applicable)

Disposition of any collected evidence

Glossary (if applicable)

22.0 REAGENT PREPARATION

Use reagent grade chemicals, unless otherwise noted. Pre-made, reagent grade chemicals can be substituted for many of the recipes below. Prepare all solutions using deionized water (dH₂O) when applicable. Wear appropriate PPE, such as gloves, and follow safety recommendations provided by the manufacturer for handling chemicals. Comply with any and all laws, regulations, or orders with respect to the disposal of any hazardous or toxic chemical, material, substance or waste. The documentation for long term use reagents shall be recorded or referenced (if recorded in another crime laboratory section's logbook) in the reagent log. Documentation for reagents intended for daily use only will be recorded in the case notes.

22.1 2-NITROSO-1-NAPHTHOL (2NN)

Part A: Ammonia hydroxide solution (20 mL NH₄OH diluted to a total of 50 mL with deionized water)

Part B: 0.2% 2NN in ethanol (0.2 g 2NN in 100 mL ethanol)

HAZMAT

Ammonium hydroxide is corrosive and will cause severe burns when contacting skin, eyes, and mucous membranes. Harmful if swallowed.

22.2 ACID PHOSPHATASE (AP)

The AP Spot Test (SERI) will be prepared following the manufacturer's directions.

Before use on samples, the working reagent shall be tested with a documented semen control each day of use. A negative control shall also be tested. The results of these tests shall be recorded in case notes.

22.3 AMIDO BLACK

22.3.1 AMIDO BLACK (METHANOL BASE SOLUTION)

Developer solution:

2 g Amido black dye (Naphthol Blue Black)
100 mL Glacial acetic acid
900 mL Methanol

Combine and mix (may take approximately 30 minutes)

Rinse Solution (De-stain)

100 mL Glacial acetic acid
900 mL Methanol

Combine and mix.

Final Rinse

1 L of deionized water is preferred; however, if not available, tap water can be used.

22.3.2 AMIDO BLACK (WATER BASED SOLUTION)

Amido Black water base formula consists of a fixative, citric acid stock, developer, and rinse solutions

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Fixative solution:

20 g 5-Sulphosalicylic Acid
1000 mL deionized water

Combine the above and mix on a stir plate until the acid is dissolved

Citric Acid stock solution:

38 g Citric Acid
2 L deionized water

Combine the above and mix on a stir plate until the citric acid is dissolved

Developer solution:

1 L Citric Acid stock solution
2 g Amido black dye (Naphthol Blue Black)
2 mL Kodak Photo Flo 200 Solution

Place the liter of citric acid stock solution onto a stirring device. Slowly add 2 g of Naphthol Blue Black and stir for approximately 30 minutes. Add the Photo Flo 200 and stir lightly.

Rinse solution:

1 L Citric Acid stock solution

STORAGE: clear or dark bottles

SHELF LIFE: indefinite

22.4 BLUESTAR

Commercially purchased: Prepare according to manufacturer's recommendations.

22.5 DITHIOOXAMIDE (DTO)

Part A: Ammonium hydroxide solution (20 mL NH_4OH diluted to a total of 50 mL with deionized water)

Part B: 2% DTO in ethanol (0.2g DTO in 100 mL ethanol).

HAZMAT

Ammonium hydroxide is corrosive and will cause severe burns when contacting skin, eyes, and mucous membranes. Harmful if swallowed.

22.6 FLUORESCIN:

22.6.1 ETHANOL BASE (STOCK SOLUTION)

0.03 g Fluorescein
15 mL ethanol
2.5 g powdered zinc
0.8 mL Glacial Acetic Acid

Mix chemicals and allow it to sit for approximately 30 minutes; the reagent should be nearly colorless after that time.

1. Working solution – 10% Stock solution in ethanol.

- In-a sprayer add 5 mL stock solution diluted to 50 mL in ethanol
2. Overspray – 3% hydrogen peroxide in ethanol (can be purchased over the counter or diluted from 30% hydrogen peroxide (1:10 in either deionized water or ethanol)

22.6.2 WATER BASE (STOCK SOLUTION)

0.1 g Fluorescein

20 mL Deionized water

1.0 g Sodium Hydroxide

2.0 g Zinc

Xanthan Gum (optional for thicker liquid on vertical surfaces. Trace amounts are added slowly)

Mix chemicals thoroughly and allow to sit for approximately 30 minutes. The reagent should be nearly colorless after that time.

1. Working Solution: Decant or pipette the reduced fluorescein solution off the zinc and dilute the solution to 1:100 in distilled water (i.e. 1 mL stock to 99 mL distilled water)

Overspray solution: The overspray solution is 3% hydrogen peroxide which can be purchased over the counter or diluted from 30% hydrogen peroxide (1:10 in either distilled water or ethanol)

22.7 LEUCO CRYSTAL VIOLET

10 g 5-Sulphosalicylic Acid (SSA) in 500ml of 3% Hydrogen Peroxide

4.4 g Sodium Acetate (NaAc)

1.1 g Leuco Crystal Violet (LCV)

Combine and mix in the order above until all of the components are dissolved.

The reagents can be adjusted accordingly to the amount needed.

Note: if the LCV crystals are yellow instead of white, do not use; this means the crystals are old.

The LCV solution will stay active for several months at room temperature. It should be stored in an amber bottle since the solution is light sensitive. It should have a one month shelf life.

22.8 LUMINOL (LAB PREPARED)

0.177 g luminol

0.199 g NaOH

0.340 g H₂O₂ (Contained in one H₂O₂-Urea Adduct Tablet)

200 mL dH₂O

Combine and mix.

Protect from light.

This reagent is QC checked each day of use.

22.9 LUMINOL

Commercially purchased: Prepare according to manufacturer's recommendations.

22.10 PHENOLPHTHALEIN

22.10.1 PHENOLPHTHALEIN STOCK SOLUTION (ALTERNATE METHOD)

2 g Phenolphthalin CAS No. 81-90-3 (HAZMAT)

20 g Potassium hydroxide (HAZMAT)

100 mL deionized water (dH₂O)

Place 20g of potassium hydroxide pellets into a 500 mL amber reagent bottle with zinc turnings and 2g of phenolphthalin powder.

Add 100 mL dH₂O to the contents of the bottle and swirl until dissolved.

The stock solution shall be stored in an appropriate container in a cold dark place (i.e. refrigerator) with some zinc added to keep it in the reduced form.

This reagent expires 3 years after its preparation. A lot number shall be assigned. Each stock lot shall be QC checked and recorded in a Reagent Log. The lot number and expiration date shall be recorded on the bottle.

22.10.2 PHENOLPHTHALEIN STOCK SOLUTION (ALTERNATE METHOD)

2.g Phenolphthalein CAS No.77-09-8 (HAZMAT)

20 g Potassium hydroxide (HAZMAT)

100 mL of dH₂O

The mixture is refluxed with 20 grams of zinc (approximately two hours) until the solution becomes colorless. The stock solution shall be stored in an appropriate container in a cold dark place (i.e. refrigerator) with some zinc added to keep it in the reduced form

HAZMAT

Phenolphthalein is a possible carcinogen.

Potassium hydroxide is corrosive and will cause severe burns when contacting skin, eyes, and mucous membranes. Harmful if swallowed.

DISPOSAL

Zinc may be stored until it is picked up by a chemical waste removal company. Zinc shall not be disposed of in waste paper basket.

22.10.3 PHENOLPHTHALEIN WORKING SOLUTION

10 mL Phenolphthalein stock solution

40 mL ethanol (EtOH)

Combine 10 mL of phenolphthalein stock solution and 40 mL ethanol.

Before use on casework samples, working reagent shall be tested with a positive blood control each day of use. A negative control shall also be tested. The results of these tests shall be recorded in the case notes.

DISPOSAL

Same as stock solution.

22.10.4 3% HYDROGEN PEROXIDE

3% Hydrogen Peroxide (1 ml)
100 µl 30% H₂O₂
900 µl dH₂O

Combine and mix.
Protect from light.
Store in a cool dark place (i.e. refrigerated)

This reagent is QC checked with the phenolphthalein working solution each day of use. The six digit expiration date (either three years from preparation or supplied by the vendor) shall be recorded on the bottle.

Commercially purchased reagent, no preparation required

22.11 **SODIUM RHODIZONATE (NaRHO)**

Part A: 15% Acetic Acid (15 mL of concentrated acetic acid diluted to 100 mL with deionized water)

Part B: A small amount of Rhodizonic Acid, disodium salt (NaRho) is diluted with deionized water to create a dark colored solution.

Part C (optional): 5% Hydrochloric Acid (HCl) (5 mL concentrated HCl diluted to 100 mL with distilled water)

A small amount of Rhodizonic Acid, disodium salt (NaRho) is diluted with distilled water to create a dark colored solution.

23.0 GLOSSARY

This glossary contains terms and definitions not specifically defined in their respective sections above.

Analyst – An individual who conducts and/or directs the analysis of forensic casework samples, interprets data, and reaches conclusions

Biohazard – Any substance that may pose the risk of biological infection

Biological Substances – Body fluids such as blood, seminal fluid, saliva, or urine or biological material such as tissue (muscle, fecal material, etc.)

Bullet – A non-spherical projectile designed for use in a rifled barrel

Cartridge – A single unit of ammunition consisting of the cartridge case which contains a primer, propellant, and the bullet or projectile(s)

Cartridge Case – The container for all of the other components which comprise a cartridge

Cast – A term used in the forensic discipline of Toolmark Identification to describe the reproduction for evidence of a toolmark or the surface of a tool made with a molding material such as silicone rubber or made with a variety of products available commercially for this purpose such as Forensic sil. The name "Forensic sil cast" is often used descriptively to represent the reproduction of evidence in this manner

Chain of Custody – In WSP CLD Crime Scene Procedures, chain of custody evidence tracking begins at the crime scene and continues to final disposition

Chemiluminescence – (sometimes "chemoluminescence") is the emission of light as the result of a chemical reaction.

Clip – A detachable metal frame or box, generally disposable, which contains cartridges and serves to facilitate the loading of an internal magazine

Contamination – The unwanted transfer of material from another source to a piece of physical evidence

Convenience Packaging – A container used primarily to aid in the transport of the evidentiary items contained within. Convenience packaging will not have an evidence seal

Crime Scene – An area, object, or person, external to a laboratory facility, from which evidence is identified, documented, collected, and/or interpreted

Crime Scene Reconstruction – The process of determining the nature of events that occurred at a scene from an evaluation of physical evidence and other relevant information

Cross-contamination – The unwanted transfer of material between two or more sources of physical evidence

Degradation – Deterioration—either partial or complete—of a biological substance by chemical or physical means such as exposure to heat, moisture, or bacterial contamination

Deoxyribonucleic Acid (DNA) – The genetic material found in various body tissues (muscle, fetal tissue, skin, etc.) and body fluids (semen vaginal fluid, blood, saliva, etc.).

Digital – Information or graphical data that has been translated into a discrete numerical value and can therefore, be manipulated and reproduced without loss of quality

Evidence – A physical object, material or item believed to have some investigative or forensic significance and defined as such by law enforcement personnel or forensic analysts

Evidence Packaging – Packaging that contains an evidence seal

Evidence Seal – A seal on evidence packaging that is tamper proof or will reveal evidence of tampering and that in accordance with CLD Operating Manual must bear the initials of the person sealing the evidence, with the evidence marking extending across the evidence seal and onto the packaging

Fabric Impression Transfers – Impression evidence found on a crime scene caused by fabrics from an object transferred to another object through impact or sustained contact

First responder(s) – The initial responding law enforcement officer(s) and/or other public safety official(s) or service provider(s) arriving at the scene prior to the arrival of the investigator(s) in charge

Initial responding officer(s) – The first law enforcement officer(s) to arrive at the scene

Magazine – A container for cartridges which has a spring and follower. The magazine serves to provide a new cartridge for loading into the chamber of the firearm during the firing cycle

Measurement Scale – An object showing standard units of length used in photographic documentation of the width and height of an items of evidence

Nonporous container – Packaging through which liquids or vapors cannot pass (e.g., glass jars or metal cans)

Personal Protective Equipment (PPE) – Articles such as disposable gloves, masks, eye protection, coveralls, and uniforms utilized to provide a barrier to keep biological or chemical hazards from contacting the skin, eyes, and mucous membranes and to avoid contamination of the crime scene

Pistol – A repeating firearm requiring a separate pull of the trigger for each shot fired, and which uses the energy of discharge to perform a portion of the operating or firing cycle

Plastic Prints – Visible prints made in soft pliable substances such as putty, modeling clay, mud, etc.

Policy – Rules governing all the operation of the CLD laboratories, including but not limited to the scientific examination of physical evidence, collection and preservation of evidence, and expert testimony regarding the scientific examinations

Porous container – Packaging through which liquids or vapors may pass (e.g., paper bags, cloth bags)

Presumptive Test – A non-confirmatory test used to screen for the presence of a substance

RAW (image file format) – A file format that contains untouched “raw” pixel information straight from the digital camera’s sensor

Revolver – A firearm, usually a handgun, with a cylinder having several chambers so arranged as to rotate around an axis and can be discharged successively by the same firing mechanism

Rifle – A firearm having rifling in the bore and designed to be fired from the shoulder

Rigor Mortis - Muscular stiffening following death. Also called postmortem rigidity

Shot – Pellets ranging in size, normally loaded into shotshells

Shotgun – A smooth bore shoulder firearm designed to fire a shotshell containing numerous pellets or sometimes a single projectile (slug). Shotguns can also be equipped with a rifled barrel

Shotshell – A single unit of ammunition consisting of the shotshell case, which contains a primer, propellant, and one or more projectiles

Shotshell Case – The shotshell container (paper or plastic) which is no longer filled with the components that originally comprise a shotshell

Shotshell Wad – The components of a shotshell, which typically separate the powder and projectiles, and are used to adjust the volume of the contents of the shotshell. Wads are made of a variety of material types, such as circular cardboard, fiber or felt disks, plastic one-piece or multi-piece shot cup and or shot columns

Single-use equipment – Items that will be used only once to collect evidence, such as biological samples, then discarded to minimize contamination (e.g., tweezers, scalpel blades)

Slug – A term applied to a single projectile loaded into shotshells

Three-dimensional Impressions – Impressions at a crime scene such as footwear or tire impressions located in soil, snow, sand, mud, or a substrate that gives dimensionality to the impression

TIFF (Tagged Image File Format) – A standardized image file exchange format that has been adopted by many manufacturers that support high resolution graphics

Tool – A term used in the forensic discipline of Toolmark Identification to describe the harder of two objects, which when brought into contact with the other object gains a mechanical advantage and results in the softer object being marked by the harder one

Toolmark – A term used in the forensic discipline of Toolmark Identification to describe the mark produced on the softer of two objects by a harder object coming into contact with it

Touch (DNA) Evidence – Evidence resulting from casual contact (often by the hands) by an individual with a surface or material (such as a steering wheel, cigarette lighter, keys, gun grips, triggers, knife handles, item of clothing, etc.) that leaves DNA available for potential analysis and identification of a suspect

Transient evidence – Evidence which by its very nature or the conditions at the scene will lose its evidentiary value if not preserved and protected (e.g., blood in the rain)

Two-dimensional Prints – Impression evidence found on a crime scene on a non-porous surface such as a footwear print on a vinyl or wooden floor or a tire print on a hard road surface

Walk-through – An initial assessment conducted by carefully walking through the scene to evaluate the situation, recognize potential evidence, and determine resources required. Also, a final survey conducted to ensure the scene has been effectively and completely processed.

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25.0 RECONSTRUCTION

The purpose of this section is to serve as a source of information for crime scene reconstruction procedures, evidence handling, and examination methods commonly utilized by the WSP CLD.

It is recognized that every crime scene is unique; and as such, the scene may require various resources in the documentation, collection, and examination of the scene.

The sources and analyses outlined in this section are those that are recommended for crime scene reconstruction. Except as otherwise noted in the procedure, the sequence and choice of examination and/or analyses are at the discretion of the analyst.

Crime scene reconstruction is the process of determining the nature and/or sequence of events that occurred at a scene using information gained from the scene, scene examination, analytical testing, autopsy report(s), photographs and/or video(s), investigative summary reports (or law enforcement reports), crime laboratory reports, other investigative information/reports (or communications), and/or experimentation.

Crime scene reconstruction includes:

- 1) General crime scene reconstruction
- 2) Bloodstain pattern analysis and reconstruction
- 3) Shooting incident reconstruction

25.1 INTRODUCTION

Crime scene reconstruction is the application of scientific principles to describe what events took place during the commission of a crime and the possible sequence of these events. Crime scene reconstruction is a dynamic process, and the process must be unbiased and is not intended to support or prove only one particular theory without considering others.

25.2 QUESTION AND THEORY

The question(s) and theory (or theories) that are to be addressed by a reconstruction may come from a variety of sources. The question(s) may be in regards to a single event or multiple, connected events. The theory (or hypothesis) is the first attempt to answer the question(s).

These sources can include:

- Law enforcement personnel
- Legal counsel
- Judges
- Pathologists
- Forensic examination

Additional analysis

During the reconstruction process, additional analysis may be required. This may include but is not limited to:

- Diagrams
- Photographs
- Experimentation/re-enactment
- Additional forensic examinations
- Visiting the crime scene

- Reviewing reports
- Physical evidence examination
- Other methods, as required

Any additional analysis must be properly recorded in the case file. Refer to the CLD QOM for information on note taking.

25.3 CONCLUSION

The conclusions(s) reached must be supported by the facts and physical evidence available at the time the reconstruction was conducted.

APPENDIX A: BLOODSTAIN PATTERN FLOW CHARTS

